GE Fanuc Automation

Programmable Control Products

TCP/IP Ethernet Communications for PACSystems™

User's Manual

GFK-2224B *July 2004*

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Caution

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GEnet	PACSystems	Series Five	VuMaster
	Proficy	Series One	Workmaster

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Contents

Chapter 1 Introduction 1-1

Other PACSystems Manuals 1-2
Ethernet Interfaces for PACSystems Controllers 1-3
PACSystems Ethernet Interface Communications Features 1-4
Ethernet Redundancy Operation 1-7

Chapter 2 Installation and Startup 2-1

Ethernet Interface Controls and Indicators 2-2
Ethernet LEDs 2-3
Ethernet Restart Pushbutton 2-4
Module Installation 2-5
Ethernet Port Connectors 2-8
Station Manager Port 2-12
Verifying Proper Power-Up of the Ethernet Interface after Configuration 2-13
Pinging TCP/IP Ethernet Interfaces on the Network 2-14

Chapter 3 Configuration 3-1

Configuration Data 3-2
Initial IP Address Assignment 3-3
Configuring the Ethernet Interface 3-7
Configuring Ethernet Global Data 3-12

Chapter 4 Ethernet Global Data 4-1

Ethernet Global Data Operation 4-2
EGD Exchanges 4-3
Sending an Ethernet Global Data Exchange to Multiple Consumers 4-6
Ethernet Global Data Timing 4-8
Timestamping of Ethernet Global Data Exchanges 4-11
Effect of PLC Modes and Actions on EGD Operations 4-14
Monitoring Ethernet Global Data Exchange Status 4-15

Chapter 5 Programming EGD Commands 5-1

COMMREQ Format for Programming EGD Commands 5-2
COMMREQ Status for the EGD Commands 5-3
Read PLC Memory (4000) 5-4
Write PLC Memory (4001) 5-7
Read EGD Exchange (4002) 5-10
Write EGD Exchange (4003) 5-13

Masked Write to EGD Exchange (4004) 5-16

Chapter 6 Network Administration 6-1

IP Addressing 6-2
Gateways 6-4
Subnets 6-5

Chapter 7 RX7i PLC Monitoring Via the Web 7-1

RX7i Home Page 7-3
Reference Tables Viewer Page 7-4
PLC Fault Table Viewer Page 7-7
I/O Fault Table Viewer Page 7-10
Downloading PLC Web Pages 7-11
Viewing the RX7i PLC Web Pages 7-14

Chapter 8 Diagnostics 8-1

Diagnostic Tools Available for Troubleshooting 8-3
States of the Ethernet Interface 8-4
EOK LED Blink Codes for Hardware Failures 8-6
PLC Fault Table 8-7
Monitoring the Ethernet Interface Status Bits 8-10
Monitoring the FT Output of the COMMREQ Function Block. 8-12
Monitoring the COMMREQ Status Word 8-13
Troubleshooting Common Ethernet Difficulties 8-23

Appendix A Configuring Advanced User Parameters A-1

Format of the Advanced User Parameters File A-3
Advanced User Parameter Definitions A-4

Chapter 1 Introduction

This chapter includes basic information about Ethernet Interfaces for the PACSystems™ family of controllers. It describes features of the Ethernet Interfaces in both conventional and redundancy systems.

The rest of this manual provides instructions for installing and applying the PACSystems Ethernet Interfaces:

Chapter 2, Installation describes user features and basic installation procedures for a PACSystems Ethernet Interface.

Chapter 3, Configuration describes assigning a temporary IP address, configuring the Ethernet interface, configuring Ethernet Global Data, and setting up the RS-232 port for Local Station Manager operation.

Chapter 4, Ethernet Global Data describes basic Ethernet Global Data operation for a PACSystems Ethernet Interface.

Chapter 5, EGD Commands describes a set of commands that can be used in the application program to read and write PLC data or Ethernet Global Data exchange data over the network.

Chapter 6, Network Administration discusses how devices are identified on the network and how data is routed among devices.

Chapter 7, RX7i PLC Monitoring Via the Web describes the Web browser feature provided by a PACSystems RX7i CPU with Embedded Ethernet.

Chapter 8, Diagnostics describes diagnostic techniques for a PACSystems Ethernet Interface. This chapter also lists CommReq Status codes.

Appendix A, Configuring Advanced User Parameters describes optional configuration of internal operating parameters used by the Ethernet interface. For most applications, the default Advanced User Parameters should not be changed.

Other PACSystems Manuals

The manuals listed below provide more information about the PACSystems family of products.

- *PACSystems CPU Reference Manual,* GFK-2222
- *PACSystems RX7i Installation Manual, GFK-2223*
- *PACSystems RX3i System Manual, GFK-2314*
- *PACSystems Hot Standby CPU Redundancy User's Guide,GFK-2308*
- *PACSystems TCP/IP Communications Station Manager Manual, GFK-2225*
- *PACSystems RX7i User's Guide to Integration of VME Modules, GFK-2235*
- *C Toolkit for PACSystems User's Manual, GFK-2259*
- *Genius Bus Controller User's Manual, GFK-2017*
- *CIMPLICITY® Machine Edition Logic Developer-PLC Getting Started, GFK-1918*
- *Installation Requirements for Conformance to Standards, GFK-1179*

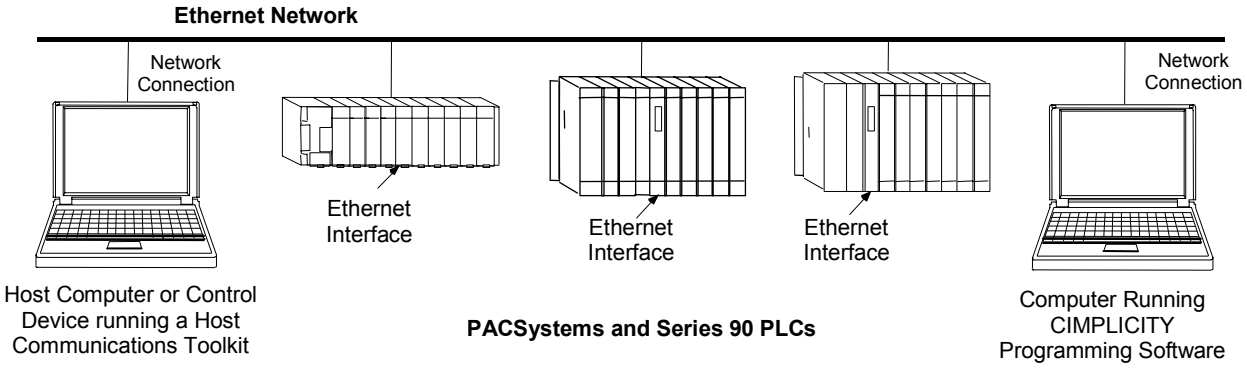
In addition to these manuals, datasheets and update documents describe individual modules and product revisions. The most recent PACSystems documentation is available online at www.gefanuc.com.

The *Infolink for PLC* CD Set of documentation for GE Fanuc PLC products is updated periodically. It can be ordered as part number IC690CDR002.

Ethernet Interfaces for PACSystems Controllers

A PACSystems Ethernet Interface enables a PACSystems controller to communicate with other PACSystems equipment and with Series 90 and VersaMax controllers. The Ethernet Interface provides TCP/IP communications with other PLCs, host computers running the Host Communications Toolkit or CIMPLICITY software, and computers running the TCP/IP version of the programming software. These communications use the GE Fanuc SRTP and Ethernet Global Data (EGD) protocols over a four-layer TCP/IP (Internet) stack.

The Ethernet Interface has SRTP "server" capability. As a *server,* the Ethernet Interface responds to requests from devices such as PLC programming software, a Host computer running an SRTP application, or another PLC acting as a client. No PLC programming is required for server operation.



The PACSystems PLC product family includes two types of Ethernet Interfaces: embedded and rack-based. The embedded Ethernet Interface is an integral part of RX7i CPU modules. The rack-based Ethernet Module plugs into a single-width slot in the PLC rack. Both the RX7i and RX3i support rack-based Ethernet modules. Both types of Ethernet Interfaces are configured using the CIMPLICITY® Machine Edition PLC programming software.

In addition to the Ethernet interface within an RX7i CPU module, up to three additional Ethernet Modules (for a total of four Ethernet interfaces) can be installed in an RX7i PLC CPU rack.

Up to four Ethernet Interface modules can be installed in an RX3i PLC CPU rack.

PACSystems Ethernet Interface Communications Features

- Full PLC *programming and configuration services*
- *Periodic data exchange using Ethernet Global Data (EGD)*
- *EGD Commands to read and write PLC and EGD exchange memory over the network.*
- *TCP/IP communication services using SRTP*
- *Redundant IP Addressing capability (with IC698CRE020 only).*
- *Basic remote PLC monitoring from a web browser (RX7i CPU Ethernet interface only)*
- *Comprehensive station management and diagnostic tools*
- *Extended PLC connectivity via IEEE 802.3 CSMA/CD 10Mbps and 100Mbps Ethernet LAN port connectors.*
- *Network switch that has Auto negotiate, Sense, Speed, and crossover detection.*
- *Direct connection to BaseT (twisted pair) network switch, hub, or repeater without an external transceiver.*
- *Protocol is stored in flash memory in the Ethernet interface and is easily upgraded through the CPU serial port.*
- *Communications with remote PLCs and other nodes reachable through routers. The gateway IP address must be configured.*
- *Internet access via web pages served up to standard web browsers, for the Ethernet interface embedded in the PACSystems CPU.*

Ethernet Interface Specifications

Ethernet processor speed	200 MHz
Connectors	- Station Manager (RS-232) Port: 9-pin female D-connector - Two 10BaseT / 100BaseTX Ports: 8-pin female shielded RJ-45
LAN	IEEE 802.2 Logical Link Control Class I IEEE 802.3 CSMA/CD Medium Access Control 10/100 Mbps
Number of IP addresses	One
Number of Ethernet Port Connectors	Two, both are 10BaseT / 100BaseTX with auto-sensing RJ-45 connection.
Embedded Ethernet Switch	Yes – Allows daisy chaining of Ethernet nodes.
Serial Port	Station Mgr Port: RS-232 DCE, 1200 - 115200 bps.

Ethernet Interface Ports

Each PACSystems Ethernet interface provides two auto-sensing 10Base T / 100Base TX RJ-45 shielded twisted pair Ethernet ports for connection to either a 10BaseT or 100BaseTX IEEE 802.3 network.

The port automatically senses the speed (10Mbps or 100Mbps), duplex mode (half duplex or full duplex) and cable (straight-through or crossover) attached to it with no intervention required.

Ethernet Media

The Ethernet Interface can operate directly on 10BaseT/100BaseTX media via its network ports.

10BaseT: 10BaseT uses a twisted pair cable of up to 100 meters in length between each node and a switch, hub, or repeater. Typical switches, hubs, or repeaters support 6 to 12 nodes connected in a star wiring topology.

100BaseTX: 100BaseTX uses a cable of up to 100 meters in length between each node and a switch, hub, or repeater. The cable should be data grade Category 5 unshielded twisted pair (UTP) or shielded twisted pair (STP) cable. Two pairs of wire are used, one for transmission, and the other for collision detection and receive. Typical switches, hubs, or repeaters support 6 to 12 nodes connected in a star wiring topology.

Station Manager

The built-in Station Manager function of the Ethernet Interface provides on-line supervisory access to the Ethernet Interface, through the Station Manager port or over the Ethernet cable. Station Manager services include:

- An interactive set of commands for interrogating and controlling the station.
- Unrestricted access to observe internal statistics, an exception log, and configuration parameters.
- Password security for commands that change station parameters or operation.

For remote Station Manager operation over the Ethernet network, the Ethernet Interface uses IP addressing. A PACSystems Ethernet Interface cannot send or receive remote Station Manager messages sent to a MAC address.

Refer to the *PACSystems TCP/IP Ethernet Communications Station Manager Manual*, GFK-2225 for complete information on the Station Manager.

Firmware Upgrades

PACSystems Ethernet interfaces receive their firmware upgrades indirectly from the PLC CPU using the WinLoader software utility. WInLoader is supplied with any updates to the Ethernet Interface software. The user connects WinLoader to the PLC CPU serial port and specifies the target module by its Rack/Slot location in the PLC.

For the CPU module, the embedded Ethernet interface firmware is upgraded along with the rest of the CPU firmware. WinLoader seamlessly upgrades first the CPU firmware and then the embedded Ethernet firmware without user intervention.

Each Ethernet Interface module's firmware must be explicitly upgraded by specifying the rack and slot location of the module to the WinLoader utility.

Built-In Web Server

The embedded RX7i CPU Ethernet Interface provides Web Server capability. A basic set of predefined web pages in English are provided; they include a home page, Reference Table data, PLC Fault Table, and I/O Fault Table. Rack-based Ethernet Interface modules do not provide Web Server capability.

Ethernet Global Data (EGD)

Each PACSystems CPU supports up to 255 simultaneous Ethernet Global Data (EGD) exchanges. EGD exchanges are configured using the programmer and stored into the PLC. Both Produced and Consumed exchanges can be configured. PACSystems Ethernet Interfaces support both selective consumption of EGD exchanges and EGD exchange production and consumption to the broadcast IP address of the local subnet.

The PACSystems Ethernet interface can be configured to use SNTP to synchronize the timestamps of produced EGD exchanges.

Beginning with PACSystems Release 2.00, PACSystems Ethernet interfaces implement the capabilities of an EGD Class 1 and Class 2 device. COMMREQ-driven EGD Commands can be used in the application program to read and write data into PACSystems PLCs or other EGD Class 2 devices.

Ethernet Redundancy Operation

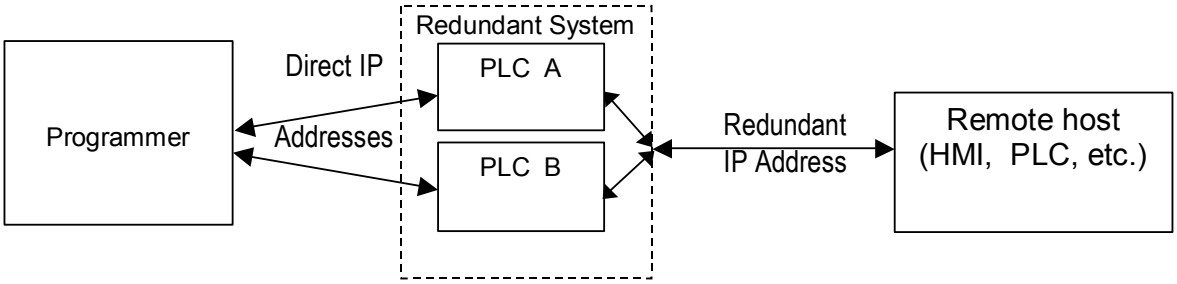
The Redundant IP feature of the Ethernet Interface allows a single IP address called the Redundant IP address to be assigned to two Ethernet modules. The two modules are in two different PLCs that are configured as a redundant system.

The Redundant IP Address is configured in addition to the normal unique (direct) IP address of each interface. Use of this feature requires a CRE020 PLC CPU.

Only one of the two Ethernet interfaces that share the Redundant IP address may use the Redundant IP address at any time; this is the “active” unit. When commanded by its PLC CPU, this Ethernet interface activates the Redundant IP address and starts responding to the Redundant IP address in addition to its direct IP address. The active unit continues responding to the Redundant IP address until it is commanded to deactivate the Redundant IP or until the Ethernet interface determines that it has lost communications with the PLC CPU.

The other unit (the “backup” unit) does not initiate communications or respond on the network using the Redundant IP address. It can only use the Redundant IP address if it is commanded by its CPU to become the active unit.

Both the active and backup unit may continue to use their individual direct IP addresses, permitting programmer connection to the active or backup PLC at any time.



Effect of Redundancy Role Switching on Ethernet Communications

When a redundancy role-switch occurs, Ethernet communications switch to the backup unit, which has no knowledge of any communication state at the previously-active unit. The application must include logic to detect loss of communication during a redundancy role switch and to then reinitiate communication.

To remote hosts on the network, the redundant system is viewed as a single PLC with high reliability; the remote host neither knows nor cares which PLC is the active unit. By using the Redundant IP address, the remote host always communicates with the active unit. When a redundancy role switch occurs, the formerly-active PLC gives up ownership of the Redundant IP address and takes down all connection-oriented communications currently using the Redundant IP address. The applications in the redundant system and remote hosts must

reestablish any such communications; the new Redundant IP connections will use the newly active PLC.

The programmer can still communicate directly with each PLC in the redundant system (for example, to store new logic or configuration) using the direct IP address of each Ethernet Interface.

SRTP Server Operation in a Redundancy System

Only the active unit maintains SRTP Server connections at the Redundant IP address and is able to respond to SRTP requests. The backup unit does not respond to the Redundant IP address. When an Ethernet interface changes from active to backup state, it takes down all SRTP Server connections and their underlying TCP connections that use the Redundant IP address.

Both the active and backup units maintain SRTP Server connections at the direct IP address for network communication with the programmer. Other remote hosts should use the Redundant IP address when communicating to a redundant system. Existing SRTP Server connections at the direct IP address are not disturbed when the Ethernet interface switches between active and backup states.

EGD Class 1 (Production & Consumption) in a Redundancy System

Only the active unit produces Ethernet Global Data exchanges to the network. The backup unit does not produce EGD exchanges. When the active Ethernet interfaces changes to backup, it stops production of all EGD exchanges.

When configured for Redundant IP operation, the active and backup Ethernet interfaces should be configured to consume EGD exchanges via multicast host groups or the local subnet broadcast address. This permits both the active and backup units to receive the latest data from the network. Unicast operation is not recommended. The backup unit does not consume any unicast exchanges at the Redundant IP address.

EGD Class 2 Commands in a Redundancy System

Remote hosts should use the Redundant IP address when communicating to a redundant system. Only the active unit responds to EGD commands. The backup unit does not respond to the Redundant IP address. When the active Ethernet interface changes to backup, any EGD command currently in process over the Redundant IP address is ended.

When configured for Redundant IP operation, only the active unit sends EGD commands on the network. If the backup unit tries to initiate any EGD commands, a COMMREQ error status is returned to its application program. When the active Ethernet interfaces changes to backup, any EGD commands in process are ended.

Although not recommend, EGD commands may be issued to the direct IP address. Both the active and backup units will respond to EGD commands received at the direct IP address.

WEB Server Operation in a Redundancy System

Only the active unit processes Web Server requests at the Redundant IP address and responds to web page requests. The backup unit does not respond to the Redundant IP address. When the active Ethernet interface changes to backup, it takes down all Web Server connections and their underlying TCP connections. The Web Server maintains its underlying TCP connection only long enough to process each web page request; a new TCP connection is opened, used, and closed for each subsequent web page display or update. So unless a web page change or update is requested during the redundancy role switch, the operation of the Redundant IP address is transparent to the Web remote browser. Any web page request in process over the Redundant IP when a role switch occurs is terminated.

Although not recommended, the remote browser may issue Web Server requests to the direct IP address. Both the active and backup units respond to Web server requests received at the direct IP address. Remote web browsers are expected to use the Redundant IP address when communicating to a redundant system.

FTP Operation in a Redundancy System

FTP operations are used to transfer setup and configuration data to the Ethernet interface, not for communication with the actual PLC application. Therefore, FTP operations should only be performed using the direct IP address.

SNTP Operation in a Redundancy System

A PACSystems Ethernet Interface can operate as an SNTP client only, so it only receives broadcast time messages from an SRTP Server on the network. SNTP operation is unaffected by the current Ethernet redundancy state or by redundancy role switches.

Remote Station Manager Operation in a Redundancy System

The remote Station Manager should respond to the direct IP address regardless of whether the unit is active or backup, or whether or not Redundant IP is configured.

Only the active unit responds to remote Station Manager commands at the Redundant IP address. The backup unit does not respond to the Redundant IP address. (Station Manager responses from the Redundant IP address can be misleading because it is difficult to determine which Ethernet interface is actually responding.)

IP Address Configuration in a Redundancy System

Redundancy systems should explicitly configure both the direct IP address and the Redundant IP address. Do not setup the direct IP address via BOOTP.

The Redundant IP address must be configured on the same local sub-network as the direct IP address and gateway IP address (if used).

Chapter 2 Installation and Startup

This chapter describes the Ethernet Interface's user features and basic installation procedures:

- Ethernet Interface Controls and Indicators
- Ethernet LEDs
- Ethernet Restart Pushbutton
- Module Installation
- Ethernet Port Connectors
  - Embedded Switch
  - Connection to a 10Base T / 100Base Tx Network
- Station Manager Port
- Powering Up the Ethernet Interface After Configuration
- Pinging TCP/IP Ethernet Interfaces on the Network

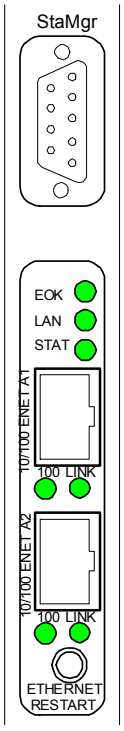
Features of the embedded CPU Ethernet Interface and the rack-based Ethernet Interface Module are the same unless noted otherwise.

Ethernet Interface Controls and Indicators

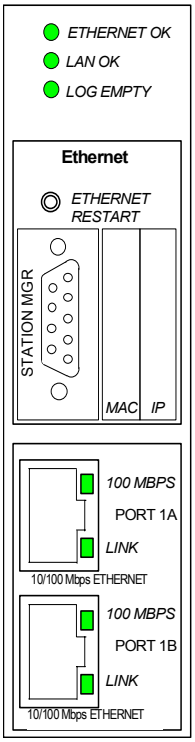
The Ethernet Interface provides:

1. Seven light emitting diode (LED) indicators
   - Ethernet Module OK (EOK)
   - LAN Online (LAN)
   - Status (STAT)
   - Two Ethernet network activity LEDS (LINK)
   - Two Ethernet network speed LEDS (100)
2. Ethernet Restart Pushbutton
3. Two 10BaseT/100BaseTX Ethernet Network Port Connectors. There is only one interface to the network (only one Ethernet address and only one IP address).
4. Station Manager (RS-232) Serial Port

Features of the embedded CPU Ethernet Interface and the rack-based Ethernet Interface Modules are the same unless noted otherwise.



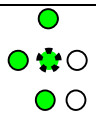
PACSystems RX7i



PACSystems RX3i

Ethernet LEDS

The **EOK**, **LAN**, and **STAT** LEDs indicate the state and status of the Ethernet Interface. For the RX3i, the Ethernet LEDs are named **ETHERNET OK**, **LAN OK**, and **LOG EMPTY**, respectively.

LED State On Blinking Off			Indicates
	EOK LAN STAT	Fast Blink Off Off	Performing Diagnostics
	EOK LAN STAT	Slow Blink Off Off	Waiting for Ethernet configuration from CPU
	EOK LAN STAT (* *EOK and STAT blink in unison*)	Slow Blink* On/Traffic/Off Slow Blink*	Waiting for IP Address
	EOK LAN STAT	On On/Traffic/Off On/Off	Operational
	EOK LAN STAT	Blink error code Off Off	Hardware failure. See chapter 8 for blink code definitions.
	EOK LAN STAT (* *All LEDs blink in unison; pattern same for awaiting or performing load*)	Slow Blink* Slow Blink* Slow Blink*	Software Load

LAN LED Operation

The *LAN* LED (*LAN OK* in RX3i) indicates access to the Ethernet network. During normal operation and while waiting for an IP address, the LAN LED blinks when data is being sent or received over the network directed to or from the Ethernet interface. It remains on when the Ethernet interface is not actively accessing the network but the Ethernet physical interface is available and one or both of the Ethernet ports is operational.

In the other states, this LED is off unless software load is occurring.

STAT LED Operation

The *STAT* LED (*LOG EMPTY* in RX3i) indicates the condition of the Ethernet interface in normal operational mode. If the STAT LED is off, an event has been entered into the exception log and is available for viewing via the Station Manager interface. This LED is on during normal operation when no events are logged.

In the other states, this LED is either off or blinking and helps define the operational state of the module.

EOK LED Operation

The *EOK* LED (*ETHERNET OK* in RX3i) indicates whether the module is able to perform normal operation. This LED is on for normal operation and flashing for all other operations. When a hardware or unrecoverable runtime failure occurs, this LED blinks a two-digit error code identifying the failure. For a list of blink codes and their meanings, see chapter 8, Diagnostics.

Ethernet Port LEDs Operation (100Mb and Link/Activity)

Each of the two Ethernet ports (Ports 1A and 1B) has two LED indicators, **100** and **LINK**. The **100** LED indicates the network data speed (10 or 100 Mb/sec). This LED is lit if the network connection at that network port is 100 Mbps.

The **LINK** LED indicates the network link status and activity. This LED is lit when the link is physically connected. It blinks when traffic is detected at that network port. Traffic at the port does not necessarily mean that traffic is present at the Ethernet interface, since the traffic may be going between ports of the switch.

Ethernet Restart Pushbutton

This pushbutton is used to manually restart the Ethernet firmware without power cycling the entire system. It is recessed to prevent accidental operation.

LED Operation during Restart

When the Ethernet firmware is manually restarted by the Ethernet pushbutton in any state, the EOK, LAN and STAT LEDs are briefly turned on in unison as an LED test. These three LEDs are turned on for ½ second and are then turned off when the firmware is restarted. The Ethernet port LEDs are not affected by a manual restart of the Ethernet firmware.

The LED test is performed only upon a manual pushbutton restart; there is no LED test when the Station Manager initiates a restart.

Module Installation

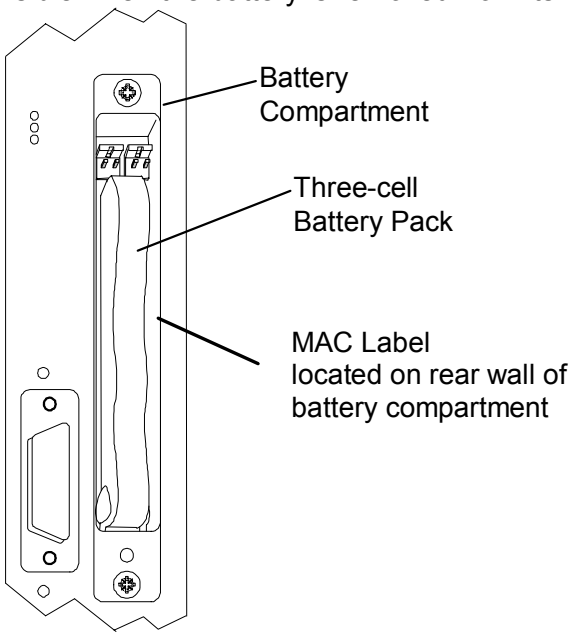
For general information about module and system installation, or if the installation requires CE Mark compliance, refer to the *PACSystems RX7i Hardware Installation Manual,* GFK-2223 or the *PACSystems RX3i Hardware Installation Manual*, GFK-2314.

Installing an RX7i CPU with Embedded Ethernet Interface

Warning

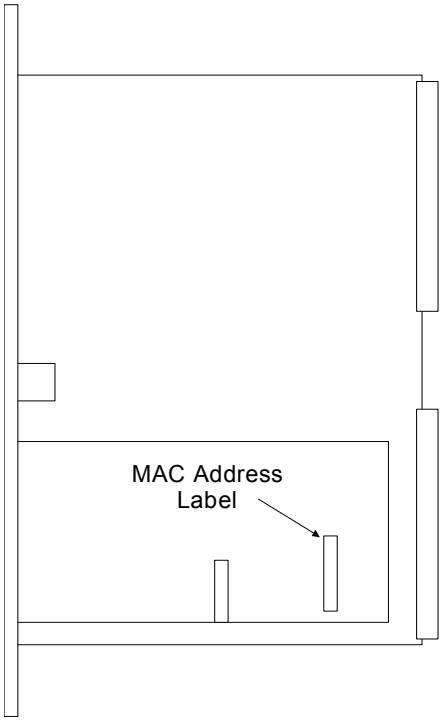
Do not insert or remove modules with power applied. This could cause the CPU to Stop, damage the module, or result in personal injury.

1. Record the 12-digit hexadecimal MAC Address from the printed label located on the rear wall of CPU battery compartment. The label is visible when the battery is removed from its compartment. (The battery does not need to be disconnected to temporarily remove it from the compartment.)
2. Connect the battery to either of the battery connectors on the module.
3. Put the toggle switch in the STOP position.
4. Make sure that rack power is off.
5. Install the CPU module in slot 1 of rack 0. Press the module firmly in place, but do not force the board. Tighten the screws on the top and bottom tabs.
6. Connect one or both of the Ethernet ports on the Ethernet Interface to the network.
7. Turn on power to the PACSystems rack.
8. Set the PLC to Stop mode via the Run/Stop switch or the programming software.



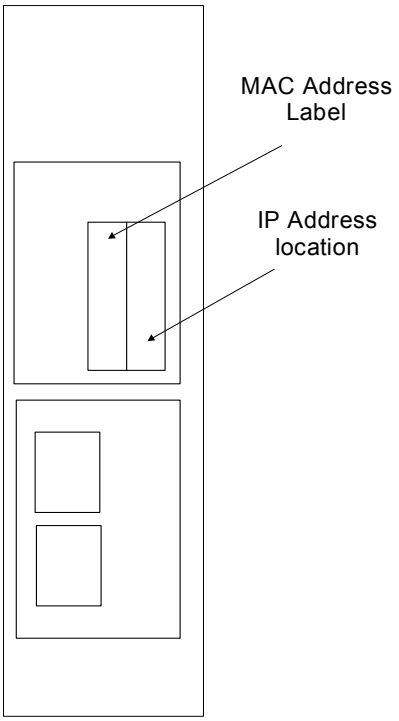
Installing an RX7i Rack-based Ethernet Interface Module

1. Record the 12-digit hexadecimal MAC Address from the printed label on the Ethernet Interface. The label is visible only with module out of the rack.
2. Be sure the rack power is OFF.
3. Slide the module into the slot for which it was configured in the system.
4. Press the board firmly in place, but do not force the board. Tighten the screws on the top and bottom tabs.
5. Connect one or both of the network ports on the Ethernet Interface to the Ethernet network.
6. Turn on power to the PACSystems rack.
7. Set the PLC to Stop mode via the Run/Stop switch or the programming software.



Installing an RX3i Rack-based Ethernet Interface Module

1. The 12-digit hexadecimal MAC Address is available on the MAC Address label located on the front of the Ethernet Interface. (For convenience, you can write the IP address of this Ethernet Interface in the space provided on the front of the module.)
2. Following the procedure in the *PACSystems RX3i System Manual*, GFK-2314, install the Ethernet module in its configured backplane slot. Press the board firmly in place, but do not force the board.
3. Connect one or both of the network ports on the Ethernet Interface to the Ethernet network.



Hot Insertion and Removal

An RX3i Ethernet Interface module may be inserted while power is applied to the PLC. Be sure to disconnect all cables, including the Ethernet network cables, from the Ethernet module before hot-inserting it into an RX3i PLC with power applied.)

For hot insertion, the module must be properly seated on the carrier with the latch engaged and all pins connected within 2 seconds. For removal, the module must be completely disengaged from the carrier within 2 seconds. It is important that the module not remain partially inserted during the insertion or removal process. There must be at a minimum of two seconds between the removal and insertion of modules.

Warning

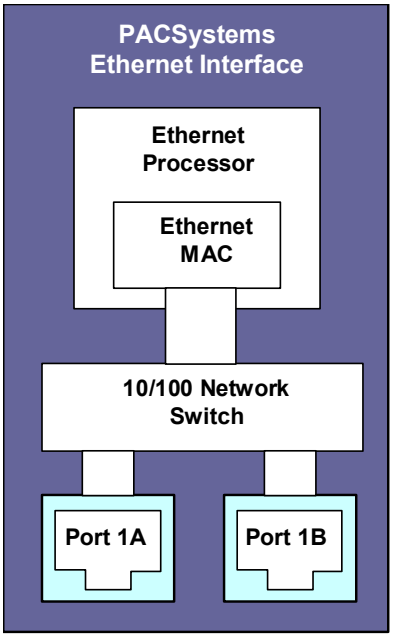
Inserting or removing a module with power applied to the system may cause an electrical arc. This can result in unexpected and potentially dangerous action by field devices. Arcing is an explosion risk in hazardous locations. Be sure that the area is non-hazardous or remove system power before removing or inserting a module.

Ethernet Port Connectors

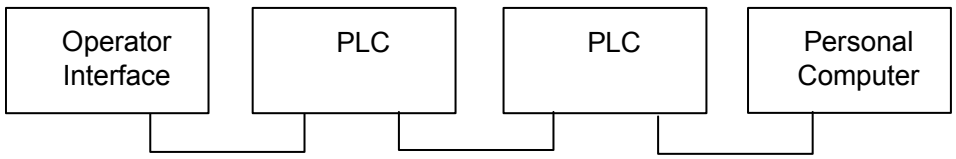
The Ethernet Interface has two Ethernet port connectors, each of which supports both 10Base-T and 100Base-Tx operation using either full duplex or half duplex operation. These 8-pin RJ-45 connectors are used to connect the Ethernet Interface to a hub, repeater, switch, or other Ethernet device.

Embedded Switch

The two Ethernet port connectors are controlled by an embedded network switch in the module. The module has only one interface to the network (one Ethernet address and one IP address).



For simple installations, the embedded switch allows devices to be connected without additional components.



It is possible to daisy-chain PLCs together without additional components, but that should be done with great care. Power loss or reset at an Ethernet interface causes loss of communication to any devices downstream from that Ethernet interface in the daisy chain. Restarting the Ethernet interface (via the Ethernet Restart pushbutton, for example) disrupts daisy chain communication.

Each switch port auto-negotiates (by default) to the correct link speed and duplex mode for the device connected to the other end of the link. Each port operates independently, so devices at two different speeds and/or duplex modes may be attached to the two ports. Each port also automatically detects the attached cable and will work properly with either straight-through or crossover cables (by default).

Caution

The two Ethernet ports on the Ethernet Interface must not be connected, directly or indirectly, to the same device. The connections in an Ethernet network based on twisted pair cabling must form a tree and not a ring, otherwise duplication of packets and network overload may occur.

Caution

The IEEE 802.3 standard strongly discourages the manual configuration of duplex mode for a port (as would be possible using Advanced User Parameters). Before manually configuring duplex mode for an Ethernet Interface port using advanced user parameters (AUP), be sure that you know the characteristics of the link partner and are aware of the consequences of your selection. Setting both the speed and duplex AUPs on an Ethernet Interface port will disable the port's auto-negotiation function. If its link partner is not similarly manually configured, this can result in the link partner concluding an incorrect duplex mode. In the words of the IEEE standard: "Connecting incompatible DTE/MAU combinations such as full duplex mode DTE to a half duplex mode MAU, or a full-duplex station (DTE or MAU) to a repeater or other half duplex network, can lead to severe network performance degradation, increased collisions, late collisions, CRC errors, and undetected data corruption."

Note: If both speed and duplex mode of an Ethernet interface port are forced using the Advanced User Parameters file, that port will no longer perform automatic cable detection. This means that if you have the Ethernet interface port connected to an external switch or hub port you must use a crossover cable. If you have the Ethernet interface port connected to the uplink port on an external switch or hub, or if you have the Ethernet interface port directly connected to another Ethernet device, you must use a normal cable.

Connection to a 10Base-T / 100Base-Tx Network

Either shielded or unshielded twisted pair cable may be attached to a port. The 10Base-T/ 100Base-Tx twisted pair cables must meet the applicable IEEE 802 standards. Category 5 cable is required for 100Base-TX operation.

Each Ethernet port automatically senses whether it is connected to a 10Base-T or 100Base-TX network, half-duplex or full-duplex. (The automatic negotiation of speed and/or duplex mode can be explicitly overridden using Advanced User Parameter settings).

10BaseT/100BaseTx Port Pinouts

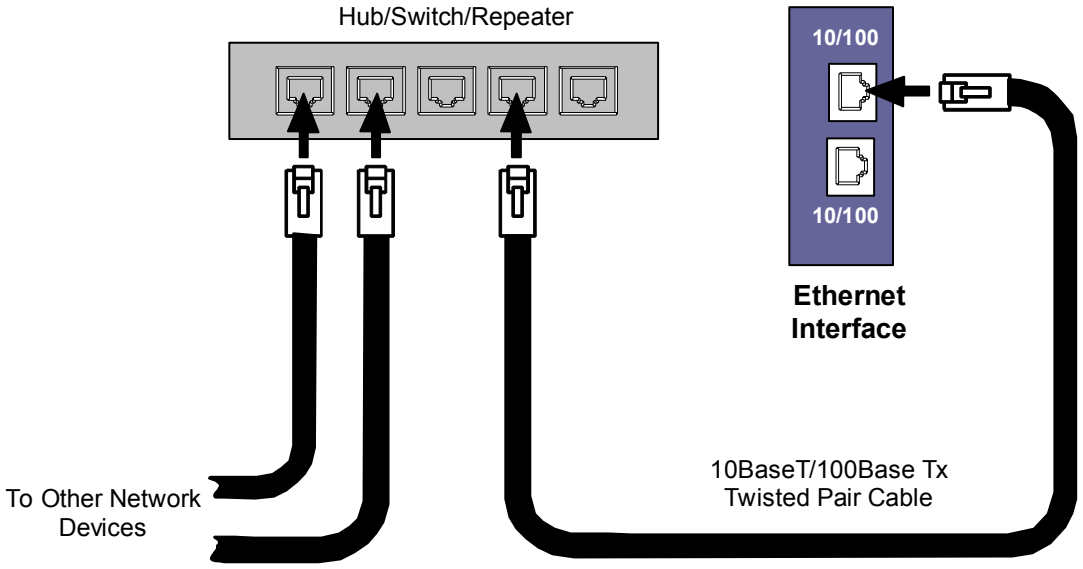
Pin Number	*Signal*	*Description*
1*	TD+	Transmit Data +
2	TD–	Transmit Data –
3	RD+	Receive Data +
4	NC	No connection
5	NC	No connection
6	RD–	Receive Data –
7	NC	No connection
8	NC	No connection

* Pin 1 is at the bottom of the Ethernet port connector as viewed from the front of the module.

Note: Pinouts are provided for troubleshooting purposes only. 10Base-T/100Base-Tx cables are readily available from commercial distributors. GE Fanuc recommends purchasing rather than making 10Base-T/100Base-Tx cables.

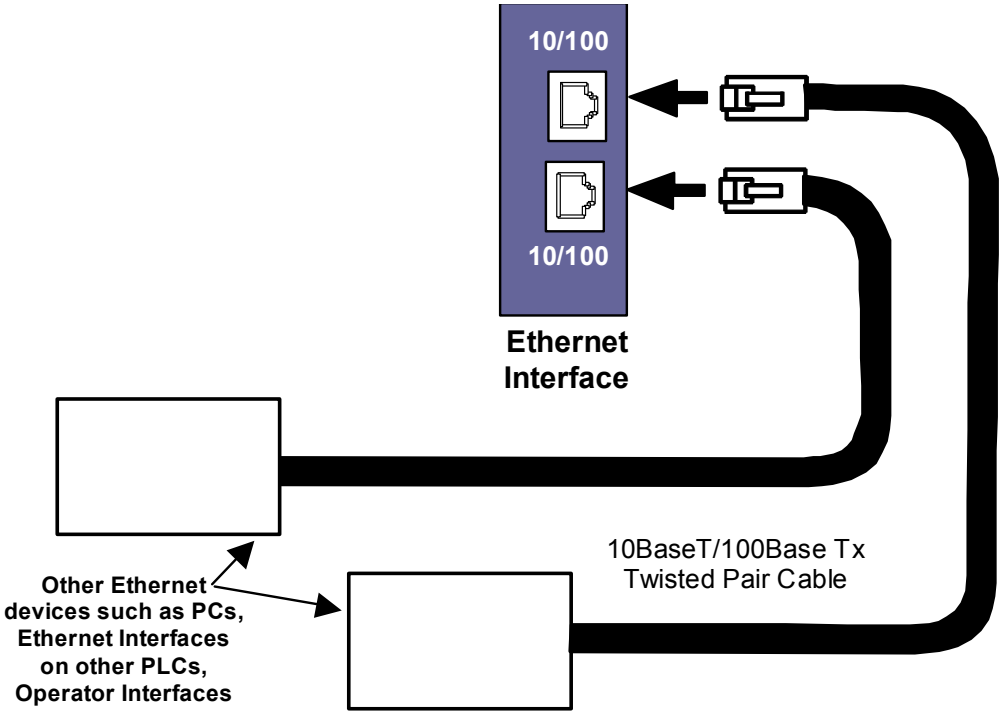
Connection Using a Hub/Switch/Repeater

Connection of the Ethernet Interface to a 10Base-T or 100Base-Tx network is shown below.



Direct Connection to the PACSystems Ethernet Interface

Connection of Ethernet devices directly to the Ethernet Interface is shown below:



Station Manager Port

Each PACSystems Ethernet interface provides a dedicated RS-232 serial port for local Station Manager use. This nine-pin D connector accepts a standard straight-through nine-pin RS-232 serial cable to connect to a standard AT-style RS-232 port.

The following cable is available from GE Fanuc:

IC200CBL001 Cable, CPU Programming

Port Settings

The serial (COM) port of the terminal or computer that is connected to the Ethernet Interface must use the same communications parameters as the Ethernet Interface.

The default values for the Station Manager port are 9600 bps, 8 bits, no parity, and 1 stop bit. If the Ethernet Interface is configured with default values for this port, or the Ethernet Interface has not been configured, use these default values. If the Ethernet Interface is configured with non-default values for this port, use those values for the serial port settings of the terminal or computer.

Station Manager (RS-232) Port Pinout

Pin No	*Signal*	*Direction*	*Description*
1*	DCD	IN	Data Carrier Detect
2	TX	OUT	Transmit Data
3	RX	IN	Receive Data
4	DSR	IN	Data Set Ready
5	GND		Signal Ground
6	DTR	OUT	Data Terminal Ready
7	CTS	IN	Clear to Send
8	RTS	OUT	Ready to Send
9	RI	IN	Ring Indicator

* Pin 1 is at the bottom right of the Station Manager port connector as viewed from the front of the module.

Verifying Proper Power-Up of the Ethernet Interface after Configuration

After configuring the Interface as described in the chapter 3, Configuration, turn power OFF to the CPU for 3–5 seconds, then turn the power back ON. This starts a series of diagnostic tests. The *EOK* LED (*ETHERNET OK* LED in the RX3i) will blink indicating the progress of power-up.

The Ethernet LEDs will have the following pattern upon successful power-up. At this time the Ethernet Interface is fully operational and on-line.

LED	Ethernet Interface Online
EOK	On
LAN	On, Off, or blinking, depending on network activity
STAT	On

In the RX3i Ethernet Interface, these LEDs are labeled ETHERNET OK, LAN OK, and LOG EMPTY, respectively.

If a problem is detected during power-up, the Ethernet Interface may not transition directly to the operational state. If the Interface does not transition to operational, refer to chapter 8, Diagnostics, chapter 8 for corrective action.

Pinging TCP/IP Ethernet Interfaces on the Network

PING (Packet InterNet Grouper) is the name of a program used on TCP/IP networks to test the ability to communicate to destinations by sending them an ICMP echo request message and waiting for a reply. Most nodes on TCP/IP networks, including the PACSystems Ethernet Interface, implement a PING command.

You should ping each installed Ethernet Interface. When the Ethernet Interface responds to the ping, it verifies that the interface is operational and configured properly. Specifically it verifies that acceptable TCP/IP configuration information has been downloaded to the Interface.

Pinging the Ethernet Interface from a UNIX Host or Computer Running TCP/IP Software

A *ping* command can be executed from a UNIX host or computer running TCP/IP (most TCP/IP communications software provides a *ping* command) or from another Ethernet Interface. When using a computer or UNIX host, you can refer to the documentation for the *ping* command, but in general all that is required is the IP address of the remote host as a parameter to the *ping* command. For example, at the command prompt type:

```
ping  10.0.0.1
```

Determining if an IP Address is Already Being Used

Note: This method does not guarantee that an IP address is not duplicated. It will not detect a device that is configured with the same IP address if it is temporarily off the network.

It is very important not to duplicate IP addresses. To determine if another node on the network is using the same IP address:

1. Disconnect your Ethernet Interface from the LAN.
2. Ping the disconnected Interface's IP address. If you get an answer to the ping, the chosen IP address is already in use by another node. You *must* correct this situation by assigning unique IP addresses.

Chapter 3 Configuration

Before you can use the Ethernet Interface, you must configure it using CIMPLICITY Machine Edition Logic Developer-PLC software. The configuration process for a PACSystems Ethernet Interface includes:

- Assigning a temporary IP address for initial network operation, such as connecting the programmer to download the hardware configuration.
- Configuring the characteristics of the Ethernet interface.
- Configuring Ethernet Global Data (if used).
- (Optional, not required for most systems). Setting up the RS-232 port for Local Station Manager operation. This is part of the basic Ethernet Interface configuration.
- (Optional, not required for most systems). Configuring advanced parameters. This requires creating a separate ASCII parameter file that is stored to the PLC with the hardware configuration. The Ethernet Interface has a set of default advanced user parameter values that should only be changed in exceptional circumstances by experienced users. The Advanced User Parameters definitions and configuration are described in appendix A.

This chapter discusses only the configuration of the PACSystems Ethernet Interface. Information about overall system configuration is available in other PACSystems documentation and in the Logic Developer online help.

Configuration Data

The PACSystems PLC is configured exclusively by the "*Proficy™ Machine Edition PLC Logic Developer"* programmer. The Programmer can be connected over the Ethernet network. For initial programmer connection, an initial IP address must be manually assigned to the Ethernet interface as described next in this chapter. The PACSystems PLC does not support autoconfiguration.

Generating / Storing / Loading the Configuration

The PACSystems Ethernet interfaces use several types of configuration data: Ethernet Configuration, optional Ethernet Global Data Configuration Configuration, and optional Advanced User Parameter (AUP) Configuration. All of these configuration parameters are generated at the programmer, stored from the programmer to the PLC CPU as part of the hardware configuration Store sequence and may be loaded from the PLC CPU into the programmer as part of the Configuration Load sequence. The optional AUP file must presently be manually generated with a text editor and then imported into the programmer. The programmer then stores any AUP files to the PLC within the Configuration Store operation. Once stored to the PLC, the PACSystems main CPU maintains the configuration data over power cycles.

Backup Configuration Data

The PACSystems Ethernet interface also saves a backup copy of the most recent Ethernet Module Initialization data, Module Configuration File data and AUP Configuration in non-volatile memory for use when the PLC is cleared. (Ethernet Global Data configuration is maintained only in the PLC CPU.) The PACSystems Ethernet interfaces maintain the backup configuration data in nonvolatile memory without battery power. (A PLC Configuration Clear does not affect the backup configuration data within the Ethernet Module.)

When the PLC configuration was not stored from the programmer, the Ethernet Module uses its backup configuration data if valid. If that data is invalid or has never been configured, factory default configuration values are used.

Locally-Edited Configuration Data

If the PLC configuration was not stored from the programmer, the CHSOSW and CHPARM Station Manager commands can be used to locally edit Ethernet configuration or AUP configuration data. These Station Manager commands are not active if the PLC configuration has been stored from the programmer.

Locally edited configuration changes cannot be retrieved into the PLC and loaded to the programmer. Locally edited configuration changes are always overwritten when a PLC configuration is stored into the PLC from the programmer.

Initial IP Address Assignment

Each PACSystems Ethernet Interface comes from the factory with a default IP address (0.0.0.0). Because this default address is not valid on any Ethernet network, an initial IP address must be assigned for initial network operation, such as connecting the programmer to download the first hardware configuration. The initial IP address must be selected for proper operation with your network and application; see your network administrator for the proper initial IP address value.

One way to assign the initial IP address is via the CHSOSW command from a local serially-connected Station Manager terminal. See *PACSystems TCP/IP Communications Station Manager Manual,* GFK-2225, for details.

Alternately, an IP address can be set using the "Set IP" method if the PLC is not in a RUN state, even if the module already has a valid configured IP Address. If the module has the factory default IP Address 0.0.0.0, a temporary IP address can be set using BOOTP over the Ethernet network, if a BOOTP server is present. Both temporary IP address assignment methods are described here.

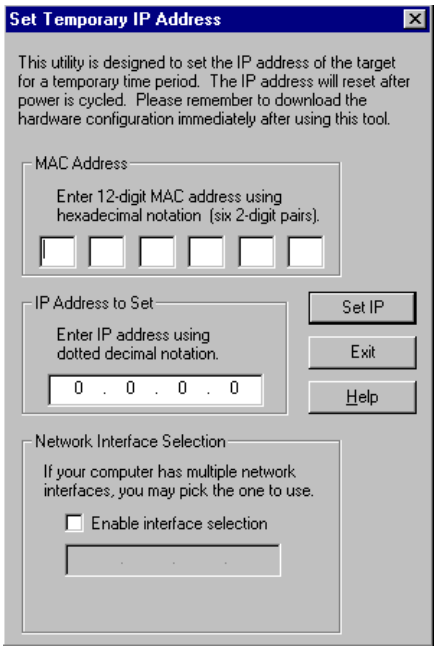
Assigning a Temporary IP Address Using the Programming Software

To initiate Ethernet communications with the programmer, you first need to set up a temporary IP address. After the programmer is connected, the actual IP address for the Ethernet interface (as set up in the hardware configuration) should be downloaded to the PLC. The temporary IP address remains in effect until the Ethernet interface is restarted, power-cycled or until the hardware configuration is downloaded or cleared.

- To use the Set Temporary IP Address utility, the PLC CPU must not be in RUN mode. IP address assignment over the network will not be processed until the CPU is stopped and is not scanning outputs.
- The current user logged on to the PC running the Set Temporary IP Address utility must have full administrator privileges.
- The Set Temporary IP Address utility can be used if communications with the networked PACSystems target travel across network switches and hubs. It does not work if communications travel through a router.
- The target must be located on the same sub-network (subnet) as the computer running the Set Temporary IP Address utility. The sub-network is specified by the computer's subnet mask and the IP addresses of the computer and the PACSystems Ethernet Interface.

To set the IP address, you need the MAC address of the Ethernet Interface. The MAC address is located on a label on the module, as shown in chapter 2, Installation. Connect the PACSystems Ethernet Interface to the Ethernet network.

1. In the Project tab of the Navigator, right-click the PACSystems target. Choose Offline Commands, then Set Temporary IP Address. The Set Temporary IP Address dialog box appears.


Set Temporary IP Address
This utility is designed to set the IP address of the target for a temporary time period. The IP address will reset after power is cycled. Please remember to download the hardware configuration immediately after using this tool.
MAC Address
Enter 12-digit MAC address using hexadecimal notation (six 2-digit pairs).
IP Address to Set
Enter IP address using dotted decimal notation.
0 . 0 . 0 . 0
Set IP
Exit
Help
Network Interface Selection
If your computer has multiple network interfaces, you may pick the one to use.
Enable interface selection

2. In the Set Temporary IP Address dialog box, do the following:
   - Specify the MAC address of the Ethernet Interface.
   - In the IP Address to Set box, specify the temporary IP address you want to assign to the Ethernet Interface.
   - If the computer has multiple Ethernet network interfaces, select the Enable Network Interface Selection check box and specify the network interface on which the PACSystems Ethernet Interface being set up is located.
3. When the fields are properly configured, click the Set IP button.
4. The Set Temporary IP Address utility verifies that the specified IP address is not already in use, then it sets the target Ethernet Interface to the specified IP address. Finally, the utility verifies that the target Ethernet Interface responds at the selected IP address. Any error or successful completion is reported. These operations may take up to a minute.

Cautions

The temporary IP address set by the Set Temporary IP Address utility is not retained through a power cycle. To set a permanent IP Address, you must set configure the target's IP Address and download the hardware configuration to the PACSystems target.

The Set Temporary IP Address utility can assign a temporary IP address even if the target Ethernet Interface has previously been configured to a non-default IP address. (This includes overriding an IP address previously configured by the programmer.)

Use this IP Address assignment mechanism with care.

Assigning a Temporary IP Address Using BOOTP

When the PACSystems Ethernet Interface receives the default IP address (0.0.0.0), either from hardware configuration or from internal backup configuration, it attempts to obtain a temporary IP address from a BOOTP server on the Ethernet network. The Ethernet Interface acts as a BOOTP client. The Ethernet Interface issues a BOOT Request to the network. If any BOOTP server on the network recognizes the Ethernet Interface, that server will return a BOOT Reply containing an IP address (and optionally a subnet mask and gateway IP address) to the requesting Ethernet Interface.

Typically, the BOOTP server must be manually configured with the MAC address and IP address (and possibly other information such as subnet mask and gateway) for each supported client device. Each supported client must be identified by its globally unique MAC address. The Ethernet Interface 's MAC address is specified on its MAC Address Label as described in chapter 2, Installation.

The BOOTP server must not be separated from the PACSystems Ethernet Interface by a router. BOOTP uses broadcast messages, which typically do not pass through routers. Consult your network administrator for more details.

Caution

The temporary IP address set by BOOTP is not retained through a power cycle. To set a permanent IP Address, you must configure the Ethernet Interface's IP Address at the programmer and download the hardware configuration to the PLC.

Redundancy systems using should explicitly configure both the direct IP address and the Redundant IP address. For redundancy operation, do not setup the direct IP address via BOOTP.

Assigning a Temporary IP Address Using Telnet

The temporary IP address assignment performed by the programmer's Set Temporary IP Address utility can be performed manually from a computer's DOS command window if the programming software is not available. This method uses an attempted Telnet connection to transfer the IP address, even though the PACSystems target Ethernet Interface does not support normal Telnet operation.

Caution

The Telnet method can assign a temporary IP address whether or not the Ethernet Interface already has in IP address, even if the Ethernet interface has been previously configured to a non-default IP address. (This includes overriding an IP address previously configured by the programming software.)

Use this IP Address assignment mechanism with care.

To temporarily set the IP address over the network, the PLC CPU must not be running. IP address assignment over the network will not be processed until the CPU is stopped and is not scanning outputs.

1. Obtain the Ethernet Interface's MAC address from its MAC Address Label as shown in chapter 2, Installation.
2. On the computer, open a standard DOS command window. Associate the desired IP address for the Ethernet Interface with the MAC address of the Ethernet Interface using the following method. In the DOS command window,enter:

```
> ARP –s ip_address mac_address
```

for *ip_address* enter the IP address being assigned to the Ethernet interface, and for *mac_address* enter the MAC address of the Ethernet interface.

3. Issue a Telnet command to the IP address (*ip_address*) being assigned to the Ethernet interface via the following command:

```
> telnet ip_address 1
```

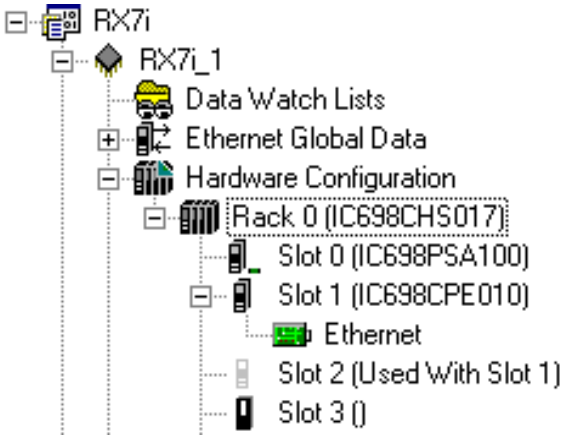
(This command is always sent to port 1.) This Telnet command will fail, but the IP address provided with the Telnet command will be passed to the Ethernet interface and will be temporarily activated.

The IP address assigned over the network remains in effect until the Ethernet interface is restarted, power-cycled or until the configuration is downloaded or cleared. Once connected, the intended IP address should be permanently downloaded to the Ethernet interface via the hardware configuration data.

Configuring the Ethernet Interface

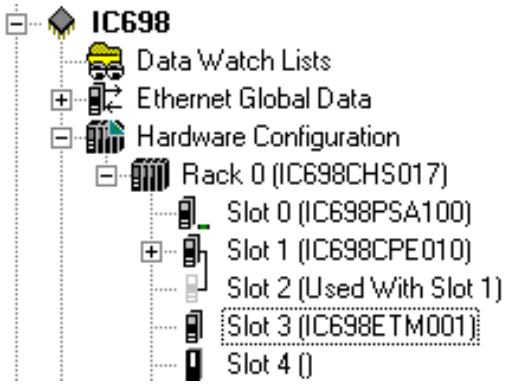
This section describes how to configure the parameters of an Embedded or Rack-based PACSystems Ethernet Interface.

Configuring an Embedded Ethernet Interface



1. In the Project tab of the Navigator, expand the PACSystems Target, the hardware configuration, and the main rack (Rack 0).
2. Expand the CPU slot (Slot 1). The Ethernet Interface daughterboard is displayed as “Ethernet”.
3. Right click the daughterboard slot and choose Configure. The Parameter Editor window displays the Ethernet Interface parameters.
4. To display the Ethernet Global Data component, right-click the PLC icon. Select ‘Add Component ‘and then ‘Ethernet Global Data’.
5. Select the desired tab, then click in the appropriate Values field.

Configuring a Rack-based Ethernet Interface Module



1. In the Project tab of the Navigator, expand the PACSystems Target, the hardware configuration, and the main rack (Rack 0).
2. Right click an empty slot and choose Add Module. The Module Catalog opens.
3. Click the Communications tab, select the IC698ETM001 module (for RX7) or IC695ETM001 module (for RX3i) and click OK. The Ethernet module is placed in the rack and its parameters are displayed in the Parameter Editor window.
4. To display the Ethernet Global Data component, right-click the PLC icon. Select ‘Add Component ‘and then ‘Ethernet Global Data’.

5. Select the desired tab, then click in the appropriate Values field. (To edit parameters of a module that is already configured in the rack, right click the slot containing the module and choose Configure.)

Ethernet Parameters (Settings Tab)

Parameters	Values
Configuration Mode	TCP/IP
Adapter Name	0.1.0
Use BOOTP for IP Address	False
IP Address	0.0.0.0
Subnet Mask	0.0.0.0
Gateway IP Address	0.0.0.0
Name Server IP Address	0.0.0.0
Maximum Web Connections	2
Maximum FTP Connections	2
Network Time Sync	None
Status Address	%I0001
Length	80
Redundant IP	Enable
Redundant IP Address	0.0.0.0
I/O Scan Set	1

Configuration Mode: This is fixed as TCP/IP.

Adapter Name: This is automatically generated based upon the rack/slot location of the Ethernet interface.

Use BOOTP for IP Address: This selection specifies whether the Ethernet must obtain its working IP address over the network via BOOTP. When set to False (= do not use BOOTP), the IP Address value must be configured (see IP Address parameter, below). When set to True, the IP Address parameter is forced to 0.0.0.0 and becomes non-editable.

IP Address, Subnet Mask, and **Gateway IP Address** : These values should be assigned by the person in charge of your network (the network administrator). TCP/IP network administrators are familiar with these parameters. It is important that these parameters are correct, otherwise the Ethernet Interface may be unable to communicate on the network

and/or network operation may be corrupted. It is especially important that each node on the network is assigned a *unique* IP address.

If you have no network administrator and are using a simple *isolated network* with no gateways, you can use the following range of values for the assignment of local IP addresses:

10.0.0.1	First Ethernet interface
10.0.0.2	Second Ethernet interface
10.0.0.3	Third Ethernet interface
.	.
.	.
.	.
10.0.0.255	Programmer TCP or host

Also, in this case, set the subnet mask, and gateway IP address to 0.0.0.0.

Note: If the isolated network is connected to another network, the IP addresses 10.0.0.1 through 10.0.0.255 must not be used and the subnet mask, and gateway IP address must be assigned by the network administrator. The IP addresses must be assigned so that they are compatible with the connected network.

Name Server IP Address : This parameter must be set to 0.0.0.0

Max Web Server Connections: (Available only when the Ethernet Interface supports web server operation.)The maximum number of web server connections. This value corresponds to the number of TCP connections allocated for use by the web server, rather than the number of web clients. Valid range is 0 through 16. Default is 2.

Max FTP Server Connections: This value corresponds to the number of TCP connections allocated for use by the FTP server, rather than the number of FTP clients. Each FTP client uses two TCP connections when an FTP connection is established. Valid range is 0 through 16. Default is 2.

> **Note:** The sum of Max Web Server Connections and Max FTP Server Connections must not exceed 16 total connections.

Network Time Sync: Selection of the method used to synchronize the real-time clocks over the network. The choices are None (for no network time synchronization) and SNTP (for synchronization to remote SNTP servers on the network). See “Simple Network Time Protocol (SNTP)” in chapter 4, Ethernet Global Data, for more information.

Status Address: The Status Address is the reference memory location for the Ethernet Interface status data. The Ethernet Interface will automatically maintain 16 LAN Interface Status (LIS) bits in this location. An additional 64 bits are reserved for future use, for a total of 80 bits.) The Status address can be assigned to valid %I, %Q, %R, %AI, %AQ or %W memory. The default value is the next available %I address. See chapter 8, Diagnostics, for definitions of the Ethernet Status data.

Note: Do not use the 80 bits assigned Ethernet Status data for other purposes or data will be overwritten.

Length: This is the total length of the Ethernet Interface status data. This is automatically set to either 80 bits (for %I and %Q Status address locations) or 5 words (for %R, %AI, %AQ and %W Status address locations).

Redundant IP: Selects whether Redundant IP operation is Enabled or Disabled. This parameter is available only when the PLC CPU supports Redundancy operation. When this parameter is set to Enabled, the Redundant IP address must be entered via the Redundant IP Address parameter, below. The default value is False.

Redundant IP Address: An optional IP Address that will be shared with another device on the network in a Redundant System. Both devices must use the same subnet mask. This parameter is available only when the Redundant IP parameter (above) is set to Enabled. This Redundant IP Address defaults to 0.0.0.0, which is not a valid IP address; a valid Redundant IP address must be explicitly configured. See chapter 1, Introduction, for more information about Ethernet redundancy. This IP address is assigned in addition to the device's primary IP address.

I/O Scan Set: Specifies the I/O scan set to be assigned to the Ethernet Interface. Scan sets are defined in the CPU's Scan Sets tab. The valid range is 1 through 32; the default value is 1.

RS-232 Port (Station Manager) Tab

These parameters are for the RS-232 Station Manager serial port. These defaults should be used for most applications.

Parameters	Values
Baud Rate	9600
Parity	None
Flow Control	None
Stop Bits	One

Baud Rate: Data rate (bits per second) for the port. Choices are 1200**,** 2400**,** 4800**,** 9600**,** 19.2k, 38.4k, 57.6k, 115.2k. The default value is 9600.

Parity: Type of parity to be used for the port. Choices are None, Even, or Odd; the default value is None.

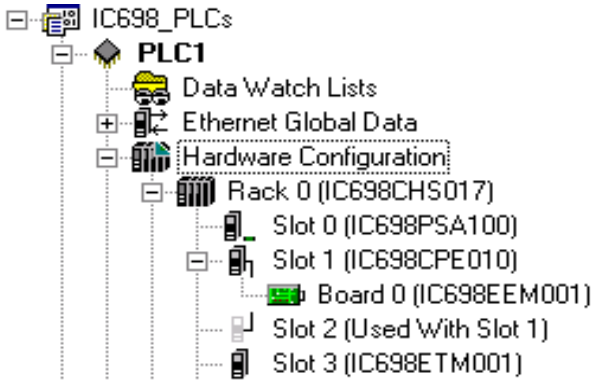
Flow Control: Type of flow control to be used for the port. Choices are None or Hardware. (The Hardware flow control is RTS/CTS crossed). The default value is None.

Stop Bits: The number of stop bits for serial communication. Choices are One or Two; the default value is One.

Configuring Ethernet Global Data

Each Ethernet Global Data exchange must be configured in both the producer and the consumer. For more information about Ethernet Global Data, see chapter 4.

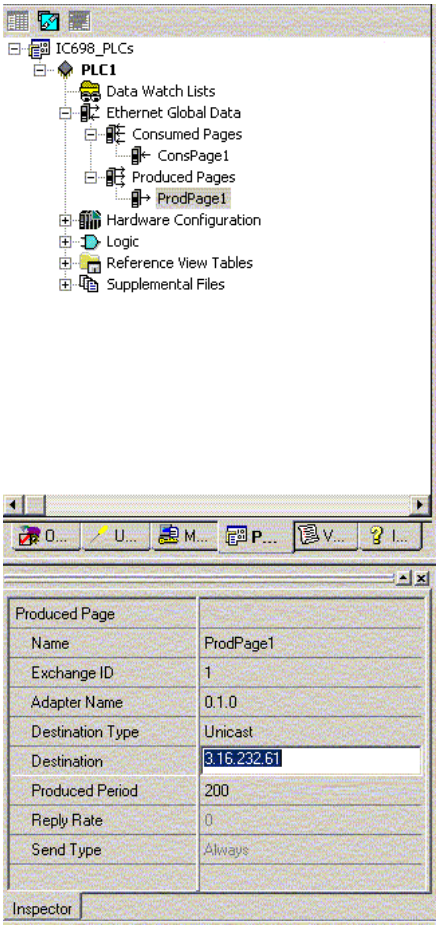
If Ethernet Global Data does not appear as shown, right-click the PLC icon (**PLC1** in this example). Select 'Add Component' and then select 'Ethernet Global Data'.



For each PLC:

1. In the PLC programming software, open the Project folder and expand the target node for the PLC.
2. To configure the Local Producer ID, right-click the Ethernet Global Data node and choose Properties. The Local Producer ID is displayed in the properties Inspector window. This parameter must be unique within the network.

   The **Local Producer ID is a** unique 32-bit value that uniquely identifies this Ethernet Global Data device across the network. By convention this is typically represented as a dotted-decimal IP address value. This value defaults to the IP address of the Ethernet interface with the lowest rack/slot location. NOTE that the Producer ID applies to all exchanges produced by this CPU, regardless of the Ethernet interface used to send the exchange to the network.



3. To add exchanges, expand the Ethernet Global Data node in the Project tab. Right click the Consumed Pages or the Produced Pages node and choose New. The new exchange appears under the selected list node.
4. For each Consumed and Produced Exchange, configure the parameters described in this section.
5. To specify the variable ranges for each exchange, right click the exchange and choose Configure Ranges. The EGD Variable Range Editor window opens.

Configuring an Ethernet Global Data Exchange for a Producer

The information to be sent by the producer and the exchange details are defined in the Properties for each Produced exchange. (The term “Produced Page” refers to a produced exchange.)

When an individual produced exchange is selected, the Properties inspector window permits user configuration of the following information:

Field	*Details*
Name	A name assigned for this exchange. Defaults to “ProdPageX” where X is a sequential number.
Exchange ID	A number that identifies a specific exchange to be sent by the producing device.
Adapter Name	The specific Ethernet Interface, identified by its rack and slot location within the producing PLC.
Destination Type	Specifies whether the data’s destination will be: ▪ An IP address (Unicast) ▪ A Group ID (Multicast) ▪ All EGD nodes on the subnet (Broadcast IP).
Destination	Identifies the data’s consuming device, based on the Destination Type selected above: ▪ a dotted-decimal IP address if Destination Type is IP Address ▪ the group’s ID (1–32) if Destination Type is Group ID ▪ the value 255.255.255.255 If Broadcast IP is the Destination Type.
Produced Period	The scheduled repetition period at which the data is produced on the network. Configure a value in the range of 0 or 2–3,600,000 (2 milliseconds to 1 hour). The value zero means at the end of the next PLC scan, but not less than 2 milliseconds from the previous production. Set the production period to ½ the period at which the application needs the data in this exchange. Round this value to the nearest 2 milliseconds.
Send Type	Fixed at “always.” In the PLC, production of EGD is controlled by the I/O state: when enabled, EGD production is enabled, and when disabled, EGD production is disabled.
Reply Rate	Not used.

Double-clicking on the produced exchange opens a window for this exchange that permits user configuration of the variables within the exchange. Each exchange has its own variable list. These variables contain the data that is produced to the network. Each variable contains the following information

Offset (Byte.Bit)	The location within the data area for this exchange where the start of the data for this variable is located. The offset is expressed as **Byte.Bit**, where *Byte* is a zero-based byte offset and *Bit* is a zero-based bit position within that byte. (Valid bit values are 0-7. Bit 0 is the least-significant bit within the byte; bit 7 the most significant.)
Variable	The name defined for this variable.
Ref Address	The PLC memory reference address that contains the start of the data for this variable.
Ignore	Not used for Produced exchange.
Length	Size of the data for this variable, expressed in units of the selected PLC reference memory type.
Type	Data type of the selected PLC reference memory type. (Automatically set up by the Ref Address selection.)
Description	An optional text description of this variable.

To add a new variable to the end of the exchange, click the '**Add'** button. This does not change the data offsets of any existing variables within that exchange.

To insert a new variable among the existing variables, click on an existing variable. When you click the '**Insert'** button, a new variable will be created ***ahead*** of the selected existing variable. This changes the data offsets of all following variables in the exchange.

Once a new variable has been entered, double-click a data field within the row to edit that value.

To delete an existing variable, click on the variable row and then click the '**Delete**' button.

Up to 100 variables may be configured for an exchange. The sum of all variables in the exchange must not exceed 1400 bytes. The total length of the exchange (in bytes) is displayed as '**Length (Bytes):**' at the top of the exchange window above the variable list.

A variable is automatically created for the required Status variable. This variable contains the local exchange status that is returned to the PLC logic application. The exchange status is not part of the produced exchange data and is not available to the network.

Configuring an Ethernet Global Data Exchange for a Consumer

The exchange details are defined in the Properties for each Consumed exchange. (The term "Consumed Page" refers to a consumed exchange.)

When an individual consumed exchange is selected, the Properties inspector window permits user configuration of the following information:

Field	*Details*
Name	A name assigned for this exchange. Defaults to "ConsPageX" where X is a sequential number.
Producer ID	The PLC producing the exchange. This value, conventionally expressed as a dotted-decimal number, uniquely identifies the Ethernet Global Data device across the network.
Group ID	Used only if the produced exchange has been configured with a Destination Type of Group ID. This Group ID (1-32) must match that of the producer.
Exchange ID	Identifies a specific data exchange to be received by the consuming device. It must match the Exchange ID specified in the produced exchange.
Adapter Name	The specific Ethernet Interface, identified by its rack and slot location within the consuming PLC.
Consumed Period	Not used. (Always displayed as 200 milliseconds; not editable.)
Update Timeout	A value in the range 0 to 3,600,000 milliseconds (1 hour). The Ethernet Interface will declare a refresh error if the first or subsequent packet of data does not arrive within this time. The Update Timeout should be at least double the producer period, and should allow for transient network delays. The default is 0 indicates no timeout. Resolution is in 2ms increments.

Double-clicking on the consumed exchange opens a window for this exchange that permits user configuration of the variables within the exchange. Each exchange has its own variable list. These variables contain the data that is consumed from the network. Each variable contains the following information

Offset (Byte.Bit)	The location within the data area for this exchange where the start of this data for this variable is located. The offset is expressed as **Byte.Bit**, where *Byte* is a zero-based byte offset and *Bit* is a zero-based bit position within that byte. (Valid bit values are 0-7. Bit 0 is the least-significant bit within the byte; bit 7 the most significant.)
Variable	The name defined for this variable.
Ref Address	The PLC memory reference address that contains the start of the data for this variable. For consumed exchanges, %S memory types and override references are not allowed. (This field is non-editable when the Ignore selection is set to True.)
Ignore	Allows consumer to ignore this variable. Setting Ignore to True means this variable is not sent to the PLC reference table. Defaults to False.
Length	Size of the data for this variable, expressed in units of the selected PLC reference memory type.
Type	Data type of the selected PLC reference memory type. (Automatically setup by the Ref Address selection.)
Description	An optional text description of this variable.

To add a new variable to the end of the exchange, click the '**Add'** button. This does not change the data offsets of any existing variables within that exchange.

To insert a new variable among the existing variables, click on an existing variable. When you click the '**Insert'** button, a new variable will be created ***ahead*** of the selected existing variable. This changes the data offsets of all following variables in the exchange.

Once a new variable has been entered, double-click a data field within the row to edit that value.

To delete an existing variable, click on the variable row and then click the '**Delete**' button.

Up to 100 variables may be configured for an exchange. The sum of all variables in the exchange must not exceed 1400 bytes. The total length of the exchange (in bytes) is displayed as '**Length (Bytes):**' at the top of the exchange window above the variable list.

A variable is automatically created for the required Status variable. This variable contains the local exchange status that is returned to the PLC logic application. The exchange status is not part of the consumed exchange data.

A variable is automatically created for the optional Timestamp variable. This variable contains the timestamp of the last received data packet (generated when the exchange was produced) that is returned to the PLC logic application. Set the Ref Address to NOT USED to ignore the timestamp variable.

Any consumed data variable may be ignored by setting the Ignore selection to True. See Selective Consumption, below.

Note: If the total data length of a consumed exchange does not match the length of the produced exchange received from the network, PLC Faults and Ethernet exceptions will occur.

Selective Consumption

Not all data ranges within a produced exchange need to be consumed by each PLC. For example, a producer is producing an exchange consisting of a 4-byte floating point value, followed by a 2-byte integer, followed by a 2-byte analog value. If the consuming PLC wants to consume only the analog value and place it into %AI003, the consumer might be configured as shown below.

Offset	Variable	Ref Address	Ignore	Length	Type	Description
0.0		Ignore	True	6	Byte	Ignore float and integer
6.0	Var01	%AI0003		1	WORD	

Note that the total length of the exchange must be the same in producer and consumer, even if the consumer is ignoring a portion of the exchange. Failure to configure any ignored bytes in the consumed exchange will result in exchange exception log and fault table entries, error status in the exchange status data, and no data being transferred for the exchange.

Chapter 4 Ethernet Global Data

This chapter describes basic Ethernet Global Data features for a PACSystems Ethernet Interface.

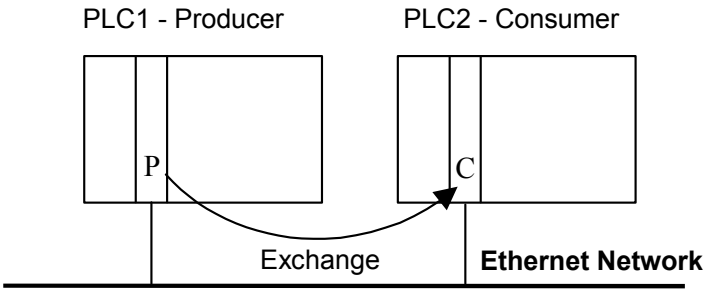
- Ethernet Global Data Operation
- EGD Exchanges
  - The Content of an EGD Exchange
  - The Data Ranges (Variables) in an EGD Exchange
  - Valid Memory Types for Ethernet Global Data
  - Planning Exchanges
  - Using Ethernet Global Data in a Redundancy System
- Sending an Ethernet Global Data Exchange to Multiple Consumers
  - Multicasting Ethernet Global Data
  - Broadcasting Ethernet Global Data
- Ethernet Global Data Timing
  - Configurable Producer Period for an EGD Exchange
  - Consumer Update Timeout Period
  - EGD Synchronization
  - Timestamping for Ethernet Global Data Exchanges
  - Effect of PLC Modes and Actions on EGD Operations
- Valid PLC Memory Types for Ethernet Global Data
- Monitoring Ethernet Global Data Exchange Status

Ethernet Global Data Operation

Ethernet Global Data is data that is automatically sent from one Ethernet device to one or more others. Once Ethernet Global Data has been configured, the data is sent automatically during system operation. No program interaction is necessary to produce or consume the global data.

The device that sends the Ethernet Global Data is called the *producer*. Each device that receives Ethernet Global Data is called a *consumer*. Each unique Ethernet Global Data message is called an *exchange*. Note: The EGD configuration screens refer to *pages* instead of exchanges. Each EGD page corresponds to a single exchange.

An Ethernet Interface can be configured to both produce and consume Ethernet Global Data at the same time, using separate exchanges.



Ethernet Global Data provides simple, regular communication of data between devices. It should not be used for event notification if possible loss of data would be significant.

The EGD Producer

The producer of an exchange periodically sends new samples of data from its local internal memory. The producer of an exchange is uniquely identified by its Producer ID. The Producer ID is a dotted-decimal number (for example, 0.0.0.1). Although the number is in IP address form, it is not used as an IP address. It is used to identify a particular PLC on the network. Since the Producer ID identifies only the PLC producing the exchange, it doesn't matter how many Ethernet Interfaces are installed in that PLC.

EGD Consumers

A consumer is a device that will update its local internal memory based on the data in an exchange. The consumer is identified at the producer by an IP Address, a Group ID, or a Subnet Mask, depending on the Destination Type selected.

The Consumed Exchange configuration allows "selective consumption" of a produced EGD exchange. The consumer takes in the whole exchange from the network but does not need to send all of the exchange to the PLC memory. This feature is called Selective Consumption. A Consumed Exchange can be set to ignore the data ranges (variables) that are not needed.

EGD Exchanges

Each exchange is identified by a specific Exchange ID. Up to 255 exchanges can be configured for a PACSystems Ethernet Interface. They can be divided into any combination of produced and consumed exchanges. Each exchange can be up to 1400 bytes in length.

Different produced exchanges can include some or all of the same data even though the exchanges are produced at different rates and sent to different consumers. Consumed Exchanges should not duplicate where the data is put as variable conflicts will occur and data will be overwritten by the multiple exchanges

Caution

Ethernet Global Data is designed for simple, efficient communication of sampled data between devices. It is not intended for event notification where the possible loss of a sample of data would be significant.

The Content of an Ethernet Global Data Exchange

Each Ethernet Global Data exchange is composed of one or more data ranges transmitted as a sequence of 1 to 1400 bytes of data. The data ranges are commonly called variables; they may be configured to correspond to PLC variables. The content of the data is defined for both the producer and consumers of the data. In this example, a producer sends an 11-byte exchange consisting of the current contents of %R00100 through %R00104 followed by the current contents of %I00257 through %I00264:

Address	*Length*	*Type*	*Description*
%R00100	5	WORD	Conveyor1 in PLC1
%I00257	1	BYTE	Conveyor1 limit switch in PLC1

The same exchange can be configured at each consumer to suit the needs of the application.

The Data Ranges (Variables) in an Ethernet Global Data Exchange

The variables within an exchange are defined in the Ethernet Global Data configuration in hardware configuration. There can be:

- Up to 100 data ranges per exchange.
- A length of 1 byte to 1400 bytes per exchange. The total size of an exchange is the sum of the data lengths of all of the data ranges configured for that exchange.

Different produced exchanges may share some or all of the same data ranges even if the exchanges are produced at different rates. A consumer does not have to consume all of the data from a produced exchange. A consumed exchange may be configured to ignore specified data ranges. (See “Selective Consumption” in chapter 3, Configuration.)

Valid PLC Memory Types for Ethernet Global Data

The PLC memory types listed below can be included in EGD exchanges.

	Description	*P-Producer C-Consumer*
%R	Register memory in word mode	P/C
%W	Word memory in word mode	P/C
%AI	Analog input memory in word mode	P/C
%AQ	Analog output memory in word mode	P/C
%I	Discrete input memory in byte mode	P/C
%Q	Discrete output memory in byte mode	P/C
%T	Discrete temporary memory in byte mode	P/C
%M	Discrete momentary memory in byte mode	P/C
%SA	Discrete system memory group A in byte mode	P/C
%SB	Discrete system memory group B in byte mode	P/C
%SC	Discrete system memory group C in byte mode	P/C
%S	Discrete system memory in byte mode	P
%G	Discrete global data table in byte mode	P/C

Discrete point references such as %I or %Q are configured as Byte-Array, Word-Array, or Dword-Array variables. That means a variable with discrete point references must be defined in blocks of 8 points if it is defined as a Byte-Array, 16 points if Word-Array, and 32 points if Dword-Array. Discrete memory must be byte-aligned.

Boolean type and Boolean-Array variables are not allowed.

Planning Exchanges

It is possible to configure more Ethernet Global Data than a PLC can transfer (especially on 10Mbit networks). If high levels of consumer timeouts occur in some or all of the consumed exchanges, the EGD load can be reduced by:

- Increasing the production period (especially if the period is more frequent than double the minimum time in which the data is needed).
- Defining fewer exchanges, each with more data.
- Using EGD groups or broadcasting to subnets. Rather than producing a directed exchange to several destinations, a single exchange can contain all the data and each consumer can transfer only the data it needs from the exchange.
- Adding another Ethernet Interface module to the rack and spreading the EGD exchanges.

Using Ethernet Global Data in a Redundancy System

When configured for Redundant IP operation, only the active unit produces EGD exchanges to the network. The backup unit does not produce EGD exchanges. When the active Ethernet interfaces changes to backup, it stops production of all EGD exchanges.

When configured for Redundant IP operation, the active and backup Ethernet interfaces should be configured to consume EGD exchanges via multicast host groups or the local subnet broadcast address. This permits both the active and backup units to receive the latest data from the network. Unicast operation is not recommended. The backup unit does not consume exchanges at the Redundant IP address.

Sending an Ethernet Global Data Exchange to Multiple Consumers

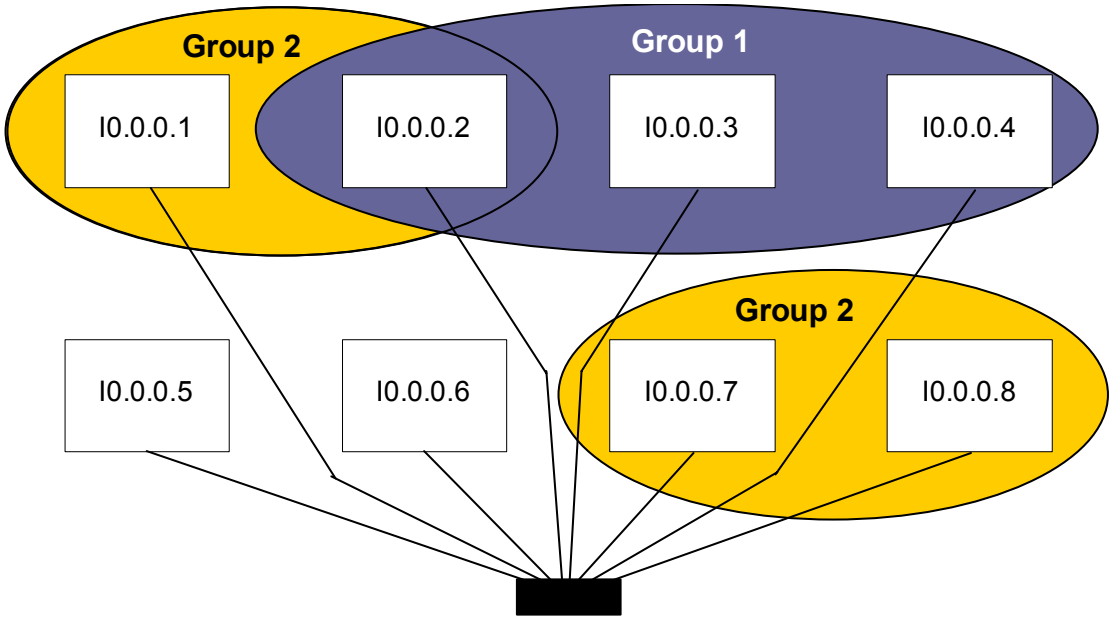
There are two ways to send an EGD Exchange to multiple consumers at the same time: by Multicasting it to a predefined group of consumers or by Broadcasting it to all of the consumers on a subnet. Both methods allow many consumer devices to simultaneously receive the same data from one producing EGD device. If an exchange is Broadcast or Multicast, the same exchange must be configured at the producer and at each consumer. Each consumer can use all of the data or just a selected portion, as configured for the consumed exchanges.

For more information about Multicasting and Broadcasting, refer to chapter 6, Network Administration.

Multicasting Ethernet Global Data

If more than one device on the network should consume a Global Data exchange, those devices can be set up as a group. The network can include up to 32 numbered groups. Groups allow each sample from the producer to be seen simultaneously by all consumers in the group.

A device can belong to more than one group, as illustrated below.



Each device in a group responds to the group's assigned ID number from 1 to 32.

Each Group ID corresponds to a Multicast (Class D) IP address reserved by the Internet authorities. The default Multicast IP addresses used by Ethernet Global Data are:

Group ID	IP Address
1	224.0.7.1
2	224.0.7.2
.	.
.	.
.	.
32	224.0.7.32

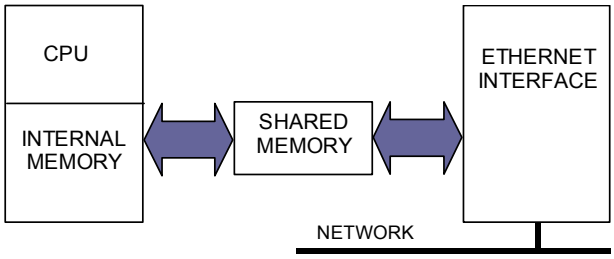
Group Multicast IP Addresses used by Ethernet Global Data should not be changed unless the defaults would cause a network conflict. If necessary, they can be changed within the reserved range of multicast IP addresses (224.0.0.0 through 239.255.255.255). The change must be made using an Advanced User Parameter File.

Broadcasting Ethernet Global Data

The same Ethernet Global Data exchange can be sent to all of the consumers on a subnet by configuring the Produced Exchange to use a Destination Type of ”Broadcast”. The “Destination” of that exchange then changes to the value 255.255.255.255. (The Ethernet Interface converts this value to the appropriate subnet broadcast mask for this network.) As with a Group ID, each consumer on the subnet can be configured to use some or all of the exchange.

Ethernet Global Data Timing

The Ethernet Interface and PLC CPU share internal memory for Ethernet Global Data operations.



In the producing PLC, the CPU updates its shared internal memory with a data sample when requested by its Ethernet Interface. The update affects the length of the PLC sweep only for that particular exchange; it has little effect on the PLC average sweep time. When the Ethernet Interface's producer period expires, it produces the data sample from shared internal memory onto the network.

In a consuming PACSystems PLC, shared internal memory is updated as soon as the Ethernet Interface gets a data sample from the network. There is no user-configurable consumer period. The CPU updates its reference tables from shared internal memory at the end of the sweep after it is notified by the Ethernet Interface that fresh data has arrived for a specific exchange. The data is made available to the application on the next PLC sweep after it is received. Some other types of Ethernet Interfaces implement a consumption period timer.

EGD Synchronization

Ethernet Global Data attempts to provide the most up-to-date process data, consistent with the configured schedule.

The Ethernet interface maintains a timer for each produced exchange. When the timer for the exchange expires, the Ethernet interface requests that the data for the exchange be transferred from reference memory during the output scan portion of the CPU sweep. At the output portion of the sweep, the CPU puts the data into the shared memory. Once the data has been transferred by the CPU sweep, the Ethernet interface immediately formulates a sample and transfers the sample on the network. (If updated data is not available at the next production timer expiration, the Ethernet interface produces a sample containing the previous data to the network.)

As soon as a sample for a consumed exchange is received, it is transferred to the CPU during the next input scan portion of the CPU sweep.

The result of this scheduling method for Ethernet Global Data is a variability of up to one producer CPU sweep time in the interval between samples produced on the network. This

variability in the time between samples is present to assure that the most up-to-date data is being transferred.

In general, it is not useful or necessary to configure the production period to be less than the CPU sweep time. If the producer period for an exchange is set lower than the CPU sweep time, the Ethernet interface will send a “stale” sample (a sample containing the same data as previously sent) at the configured interval. When the fresh CPU data becomes available at the end of the sweep, the Ethernet interface will immediately send another sample with the fresh data. The timer of the produced exchange is not reset when this sample is sent. This can result in more samples in the network than would be expected from the configured period.

Configurable Producer Period for an EGD Exchange

The Producer period for an EGD exchange can be 2 milliseconds to one hour. In the PLC, the Ethernet Interface attempts to produce the data at this interval. As explained above, the exchange production may vary from the configured interval by up to one production period or one producer CPU sweep period, which ever is smaller. .

Producer period is configurable in increments of 2 milliseconds. If the Producer Period is set to zero, production is scheduled every scan or every 2ms, whichever is slower. In a PLC with rapid scan times, scheduling a produced exchange at zero results in a very high load on the network and on the Ethernet Interface, which can degrade overall Ethernet performance. Scheduling multiple exchanges for a zero period in a PLC with a low scan time can result in the Ethernet Interface being unable to produce all the required data, and will also degrade SRTP communication.

Consumer Update Timeout Period

For each consumed exchange, an Update Timeout period can be configured. It determines how long the Ethernet Interface will wait for the starting or subsequent packet of data in the exchange before declaring a refresh error. The update timeout period for the consumer should be set to at least twice the producer period. At very small producer periods, the update timeout should also allow for network transfer variation. Otherwise, the PLC may occasionally falsely report refresh faults. Use zero for the update timeout period of a consumed exchange to disable timeout detection.

Producer Period Guidelines for PLCs

Do not produce and consume data faster than is required by your application. This reduces the load on the network and on the devices, providing capacity for other transfers.

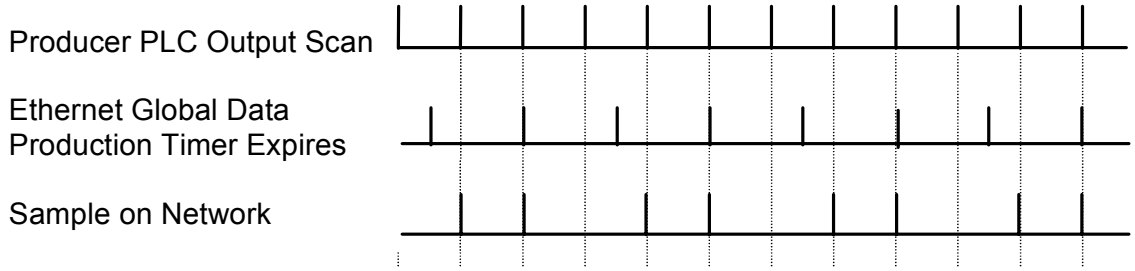
Timing Examples

The following illustrations show the relationship between the PLC output scan time, the produced exchange timer, and data samples on the network.

Example 1

Only one sample is produced on the network per producer period expiration. The variability between samples can be up to producer CPU sweep time.

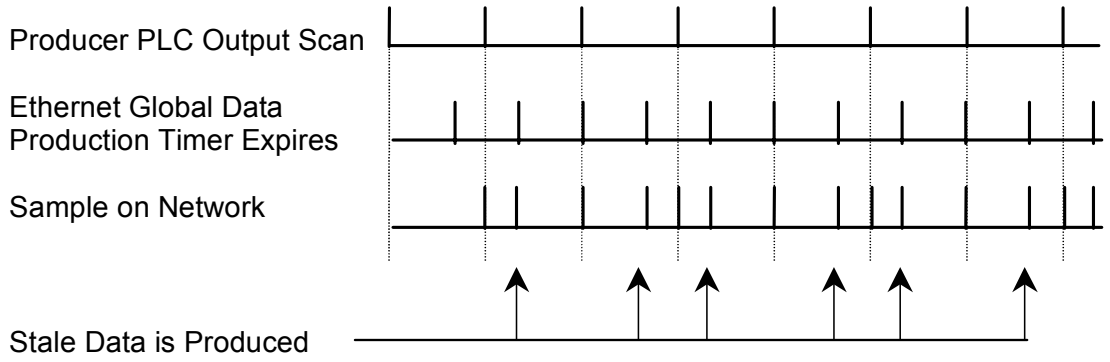
Producer Period = 1.5 Times CPU Sweep



Example 2

More than one sample can be produced per producer period expiration and stale samples are produced to the network.

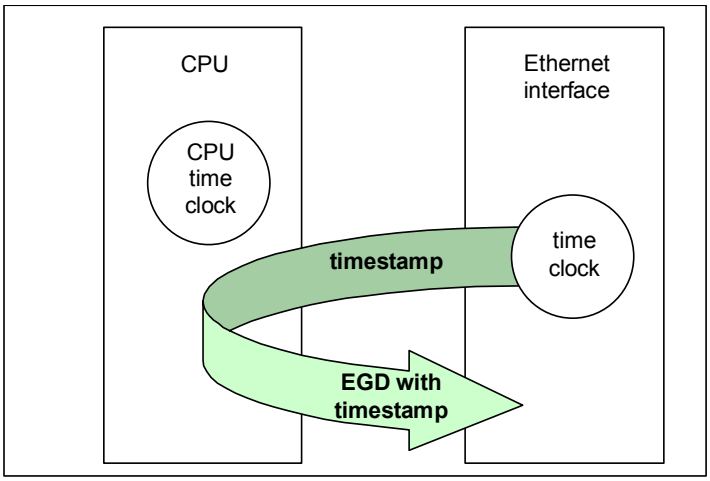
Producer Period = 2/3 Time of CPU Sweep



Timestamping of Ethernet Global Data Exchanges

The PLC CPU adds a timestamp to each Ethernet Global Data Message it produces. The timestamp indicates when the data was transferred from the producing PLC's CPU to its Ethernet interface for transmission over the network.

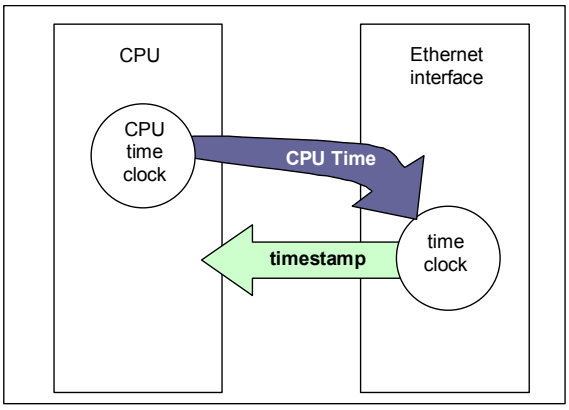
The timestamp is an 8-byte value representing the time elapsed since midnight, January 1, 1970. The first four bytes contain a signed integer representing seconds and the next four bytes contain a signed integer representing nanoseconds. This value can be examined to determine whether a packet received from the network has a new data sample or if it is the same data received previously.



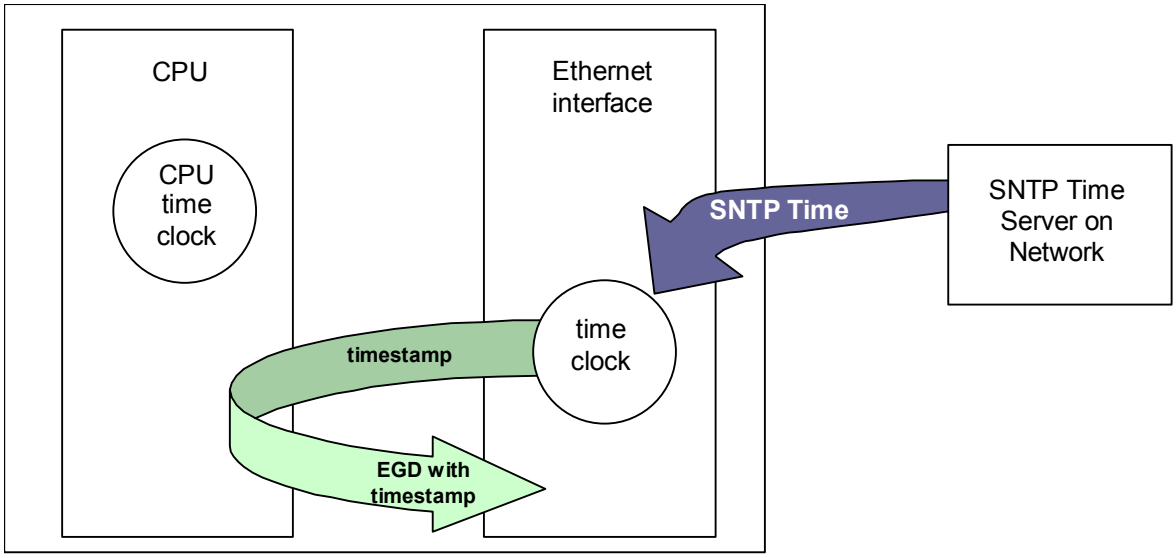
The PLC CPU obtains the timestamp data from the time clock in the Ethernet interface. The CPU only uses this timestamp for Ethernet Global Data exchanges. The timestamp from the Ethernet interface does not affect the time of the CPU's internal time clock.

The time clock in the Ethernet Interface is synchronized to either the clock in the CPU or an external SNTP server on the network. Selection of the timestamp source for Ethernet Global Data is part of the basic configuration of the Ethernet Interface, as explained in chapter 3, Configuration.

PLC's Time Clock: If this source is configured, the Ethernet Interface's built-in time clock is synchronized at power-up or at restart to the clock in the PLC CPU. The timestamp information produced by the PLC has a resolution of 100 microseconds. Because the time clocks in the PLCs on the network are not synchronized, EGD timestamps produced by different PLCs cannot be compared accurately.



SNTP Server's Time Clock: if this source is configured, the Ethernet Interface's built-in clock is periodically synchronized to the clock on an SNTP server on the network. All Ethernet Interfaces configured to use SNTP will have updated, synchronized timestamps. Therefore, accurate timing comparisons between exchanged data can be made. If SNTP is used to perform network time synchronization, the timestamp information typically has ±10 millisecond accuracy between PLCs on the same network.



SNTP Operation

In an SNTP system, a computer on the network (called an SNTP server) sends out a periodic timing message to all of the SNTP-capable Ethernet Interfaces on the network, which keep their internal clocks synchronized with this SNTP timing message.

In a redundancy system. SNTP operation is unaffected by the current Ethernet redundancy state or by redundancy role switches.

SNTP server dates before January 1, 1989 are not supported.

Normal SNTP Operation

The Ethernet Interface will synchronize to a remote SNTP time server after receiving two broadcast clock values within a 150-second period. The Station Manager can be used to view server status information.

Multiple SNTP Servers

To guard against loss of SNTP timing messages, multiple SNTP time servers can be tracked on a network. An Ethernet Interface can maintain timing information from up to four total SNTP time servers at a time. Each server assigns a stratum number that determines its priority. The message from the server with the lowest stratum number is used by the Ethernet

Interface until communication with that server is lost. Then the server with the next lowest stratum number becomes the server of choice and the Ethernet Interface synchronizes to it if it receives two of its timing messages within a 150-second period. A server is considered "lost" if more than 150 seconds elapse between timing messages.

Loss or Absence of SNTP Timing Signals

If an Ethernet Interface is configured for SNTP, but does not receive two timing messages from an SNTP network time server within a 150-second period, the following will happen:

- A fault entry will be placed in the PLC Fault Table.
- A fault entry will be placed in the Ethernet Interface's exception log. This log can be read using the Station Manager.
- The Status word within a consumed exchange will indicate new data with a value of 3, instead of the normal 1 value, indicating that SNTP is selected, but the Ethernet Interface is not synchronized to an SNTP server. This Status word value can be obtained from the PLC register configured for the particular exchange.

Note: The SNTP error condition is considered the least important of all possible error codes. Therefore, if another error condition exists, its status code will appear in the Status word instead of the SNTP error code.

Upon loss or absence of synchronization, the Ethernet Interface’s built-in clock will operate as follows:

- If the Ethernet Interface, after its last power-up/restart cycle, has never received an SNTP server's timing message, it will continue to use the PLC CPU's local clock value that it received at power-up/restart for its time base.
- If the Ethernet Interface has been synchronized to an SNTP server but lost its signal, it will use the most recently received SNTP time message as its time base.

The Ethernet Interface will continue supplying time values to the PLC CPU for timestamping, while it "listens" for SNTP timing messages from the network. If SNTP messages are received later, the Ethernet Interface will then synchronize to them

Effect of PLC Modes and Actions on EGD Operations

The configuration and operation of Ethernet Global Data may be affected by the PLC's current mode and by certain PLC actions:

- The normal PLC mode for EGD operation is RUN with Outputs enabled. In this PLC mode, Ethernet Global Data remains configured and exchanges are both produced and consumed.
- If the PLC mode is set to STOP with I/O disabled, the Producer ID remains configured, but production and consumption stop. Note that while consumed data is not transferred to the PLC memory in this mode, data from the network is still transferred to the shared memory so that the latest data is available immediately when the PLC transitions out of STOP with I/O disabled mode.
- If configuration is lost, the Ethernet Global Data configuration must be stored again.

PLC Mode or Action	***Producer ID remains configured***	***Configuration-Based Exchanges continue to be***		
		Configured	***Produced***	***Consumed***
PLC Mode				
RUN-Outputs Enabled	YES	YES	YES	YES
RUN-Outputs Disabled	YES	YES	NO	YES
RUN-SUSPEND I/O [1]	YES	YES	NO	NO
STOP-I/O Enabled	YES	YES	YES	YES
STOP-I/O Disabled	YES	YES	NO	NO
PLC Action				
RUN-Store Logic	YES	YES	YES	YES
STOP-Store Logic	YES	YES	*	*
STOP-Clear Logic	YES	YES	*	*
STOP-Config Store	Replaced[2]	Replaced[2]	NO[3]	NO[3]
STOP-Clear Config	NO	NO	NO	NO
PLC Power Cycle	YES	YES	*[3]	*[3]
Ethernet Interface Restart	YES	YES	*[3]	*[3]

* Production and consumption is controlled by the PLC Mode as described above.

[1] RUN-SUSPEND I/O refers to the SUSIO logic function. (The DOIO logic function does not affect EGD production or consumption.)

[2] Producer ID and exchange definitions are replaced.

[3] Producer ID and exchange states depend on the PLC mode and configuration prior to the action.

Monitoring Ethernet Global Data Exchange Status

The Exchange Status word is used to store status information about an EGD exchange. A unique Exchange Status word location must be is configured for each exchange.

The PLC writes status codes into the Exchange Status word:

- upon exchange is transferred or a consumer timeout occurs

The Exchange Status word is typically set to 1, indicating that when the period expired, there was no error condition. The application program can monitor for error conditions reported in the Exchange Status word by setting it to 0 once a non-zero value is written to it. The program should also monitor the “LAN Interface OK” Status bit (see chapter 8, Diagnostics) for each of the Ethernet Interfaces performing EGD. The Exchange Status word is invalid if the bit is 0.

Note that when an EGD exchange message received from the network contains an invalid Protocol Version Number, the Ethernet Interface cannot decode the message in order to identify the exchange. In this case, the Exchange Status Word cannot be updated.

Exchange Status Word Error Codes

The following table shows the error codes that can be written to the Exchange Status word in the Producer (P) and Consumer. The Exchange Status Word value for each exchange may be displayed via the STAT G Station Manager command. The Exchange Status Word values are displayed within parentheses.

Value (Dec.)	*P / C*	*Error*	*Description*
0	P/C	No new status event has occurred.	Produced: Initial value until the first producer period refresh occurs. Consumed: The data has not been refreshed since the previous consumption scan and the consumer timeout has not expired.
1	P	No error currently exists.	The exchange is producing data. This value should be ignored in the Output Disabled PLC modes.
1	C	No error, data consumed.	The data has been refreshed on schedule since the previous consumption.
3	C	SNTP error.	The Ethernet Interface in the producer is configured for network time synchronization, but is not synchronized to an SNTP server. The data was refreshed on schedule.
4	P/C	Specification error.	During exchange configuration, an invalid configuration parameter was received by the Ethernet Interface or an error occurred in communication with the PLC CPU.
6	C	Refresh timeout without data.	The exchange's timeout period is configured to a non-zero value and the data has not been refreshed within the timeout period.
7	C	Data after refresh timeout.	The data has been refreshed since the previous consumption, but not within the timeout period.
10	P/C	IP Layer not currently initialized.	This status can be set during exchange configuration* if the Ethernet Interface detects that it cannot currently access a network. This temporary status can change if successful network access becomes possible.
12	P/C	Lack of resource error.	Local resources are not available to establish the exchange during exchange configuration*. The PLC Fault Table may provide more detail on the specific error.
14	C	Data size mismatch error	The data size of a consumed exchange does not match the exchange definition. The exchange is ignored.

- Exchange configuration occurs when either 1) Hardware Configuration containing EGD is stored to the PLC, 2) a PLC containing EGD configuration powers up, or 3) an Ethernet Interface configured for EGD is restarted.

Chapter 5 Programming EGD Commands

This chapter describes a set of commands that can be used in the application program to read and write data over the Ethernet network:

- Read PLC Memory
  - Write PLC Memory
  - Read EGD Exchange
  - Write EGD Exchange
  - Masked Write to EGD Exchange

Using EGD Commands in a Redundancy System

When two Ethernet Interfaces are configured for Redundant IP operation (see chapter 1, Introduction, for more information), only the active unit sends or responds to EGD commands. The backup unit does not send or respond to the Redundant IP address. If the backup unit tries to send an EGD command, a COMMREQ error status is returned to its application program.

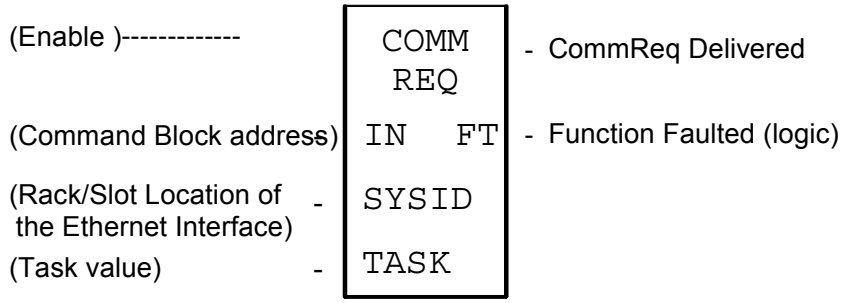
If the active Ethernet interface changes to backup status, it takes down all RDS sessions that use the Redundant IP address. Any EGD command currently in process over the Redundant IP address when a role switch occurs is ended.

Although not recommend, EGD commands may be issued to the direct IP address. Both the active and backup units will respond to EGD commands received at the direct IP address. (Remote hosts should use the Redundant IP address when communicating to a redundant system.)

COMMREQ Format for Programming EGD Commands

The EGD commands described in this chapter are sent using the Communications Request (COMMREQ) function.

The Communications Request is triggered when the logic program passes power to the COMMREQ Function Block.



For the EGD commands, the parameters of the COMMREQ are:

Enable: Control logic for activating the COMMREQ Function Block.

IN: The location of the Command Block. The Command Block contains the parameters of the COMMREQ request. It can be located at any valid address within a word-oriented memory area (%R, %AI, %AQ, %P, %L, or %W) in the PACSystems PLC. Parameters for the EGD commands are described on the following pages.

SYSID: A hexadecimal word value that gives the rack (high byte) and slot (low byte) location of the Ethernet Interface. For example, an Ethernet Interface in rack zero, slot six would use the value 6 for this parameter. For the PACSystems CPU embedded Ethernet interface, enter the rack/slot location of the CPU module.

TASK: For the PACSystems CPU embedded Ethernet interface, Task must be set to the value 65536 (10000H) to address the CPU's Ethernet daughterboard. For a PACSystems Ethernet module, Task must be set to zero.

FT Output: The FT output is set if the PLC CPU is unable to deliver the COMMREQ to the Ethernet interface. When the FT output is set, the Ethernet Interface is unable to return a COMMREQ status word to the PLC logic application.

COMMREQ Status for the EGD Commands

Words 3 and 4 of every COMMREQ Command Block specify a memory type and location to receive status information about the execution of the command.

Word 3 specifies the memory type for the COMMREQ status word. The memory types are listed in the table below:

Type	Value (Decimal)	Value (Hex.)	Description
%R	8	08H	Register memory (word mode)
%AI	10	0AH	Analog input memory (word mode)
%AQ	12	0CH	Analog output memory (word mode)
%I	16	10H	Discrete input memory (byte mode)
	70	46H	Discrete input memory (bit mode)
%Q	18	12H	Discrete output memory (byte mode)
	72	48H	Discrete output memory (bit mode)
%T	20	14H	Discrete temporary memory (byte mode)
	74	4AH	Discrete temporary memory (bit mode)
%M	22	16H	Discrete momentary internal memory (byte mode)
	76	4CH	Discrete momentary internal memory (bit mode)
%G	56	38H	Discrete global data table (byte mode)
	86	56H	Discrete global data table (bit mode)
%W	196	C4H	Word memory (word mode; limited to %W1-%W65536)

Word 4 of the COMMREQ Command Block specifies the offset within the memory type selected. ***The status word address offset is a zero-based number.*** For example, if %R1 should be the location of the status word, you must specify a zero for the offset. The offset for %R100 would be 99 decimal. (When using %W memory, the maximum offset value that can be entered is 65535, signifying %W65536.)

COMMREQ Status Values

The Ethernet Interface reports the status of the COMMREQ back to the status location. See chapter 8, Diagnostics, for COMMREQ status values that may be reported for the EGD commands.

Read PLC Memory (4000)

The Read PLC Memory command can be used to read memory locations from a remote PACSystems PLC. This command does not require configuration of a produced / consumed exchange in the PLCs. The Read PLC Memory command can only be sent to an individual IP Address; it cannot be sent to a Group ID (multicast).

Read PLC Memory Command Block

Word Offset	Value	Description
Word 1	Length of command data block, including optional password data	16 plus optional password data size in Word 22.
Word 2	0	Always 0 (no-wait mode request)
Word 3	(See previous page)	Memory type of COMMREQ Status Word
Word 4	0-based.	Offset of COMMREQ Status Word
Word 5	0	Reserved
Word 6	0	Reserved
Word 7	4000 (fa0H))	Read PLC Memory command number.
Word 8	Timeout, in milliseconds	The maximum time to wait for a response, in 10-millisecond increments. Default is 1000ms. A timeout must be specified. If 0 is entered, the default of 1000ms is used.
Word 9	Local read buffer memory type	Memory type for the data to be placed in the local PLC.
Word 10, Word 11	Local read buffer reference table starting address	1-based offset in the local PLC
Word 12	Remote read location memory type	Memory type from which data will be read in the remote PLC
Word 13, Word 14	Remote reference table read location starting address	1-based offset in the remote PLC
Word 15	Remote reference table length (in remote memory units)	Number of remote memory units to be read.
Word 16	Network address type	Must be 1. Indicates an IP address will be used.
Word 17	Network address length	Must be 4 for IP address. Group ID (multicast) is not permitted.
Word 18 – Word 21	IP Address of the remote PLC	Four integers, specified as one integer per word of the dotted-decimal IP address of the remote PLC. May not be a group IP address.
Word 22	Password length, required	Number of characters in the password, including the NULL termination character. Must be set to 0 if a password is not included.
Word 23 – end	Password, optional	NULL terminated. This is the optional password that may be required to access the remote PLC.

* Word 4 (COMMREQ status word address) is the only zero-based address in the Command Block. Only this value requires subtracting 1 from the intended address.

(Word 7) EGD Command Number: Word 7 requests that a read PLC memory operation occur. If the command is processed successfully, it will result in PLC reference memory data being retrieved from the server to the client.

(Word 8) Read Command Timeout: Word 8 specifies the time (in milliseconds) the Ethernet Interface will wait for the command to complete before returning an error status in the COMMREQ status word. If the timeout is specified as zero, no timeout error will be reported.

(Word 9) Local PLC - Memory Type: Words 9-11 specify the location in the local PLC where the Ethernet Interface will store data received from the remote PLC. Valid values for Word 9 are listed below. The amount of data to be transferred is specified by the number of memory units of the data read from the remote PLC (Word 15).

Type	*Value (Decimal)*	*Description*
%W ‡	196	Word memory (word mode)
%R	8	Register memory (word mode)
%AI	10	Analog input memory (word mode)
%AQ	12	Analog output memory (word mode)
%I	16 70	Discrete input memory (byte mode) Discrete input memory (bit mode)
%Q	18 72	Discrete output memory (byte mode) Discrete output memory (bit mode)
%T	20 74	Discrete temporary memory (byte mode) Discrete temporary memory (bit mode)
%M	22 76	Discrete momentary internal memory (byte mode) Discrete momentary internal memory (bit mode)
%SA	24 78	Discrete system memory group A (byte mode) Discrete system memory group A (bit mode)
%SB	26 80	Discrete system memory group B (byte mode) Discrete system memory group B (bit mode)
%SC	28 82	Discrete system memory group C (byte mode) Discrete system memory group C (bit mode)
%S †	30 84	Discrete system memory (byte mode) Discrete system memory (bit mode)
%G	56 86	Discrete global data table (byte mode) Discrete global data table (bit mode)

† Read-only memory, cannot be written to.

‡ %W memory is supported on PACSystems clients and servers only.

(Words 10 - 11) Local PLC - Memory Starting Address: Words 10 and 11 determine the starting address in the local PLC in which the data from the remote PLC is to be stored. The value entered is the 32-bit offset (1-based) from the beginning of PLC memory for the memory type and mode specified in Word 9. Word 10 contains the least significant 16 bits of the offset; word 11 contains the most significant 16 bits of the offset. This offset will be either in bits, bytes, or words depending on the mode specified. (For example, if Word 9=16 and Words 10,11 = 2, 0 then the starting address will be %I9.) Valid ranges of values depend on the PLC's memory ranges. The user is responsible for assuring that this area is large enough to contain the requested data without overwriting other application data.

(Word 12) Remote PLC - Memory Type: Words 12–14 specify the memory type and starting address in the remote PLC from which the data is to be read. Valid values for Word 12 are listed above.

(Words 13 - 14) Remote PLC - Memory Starting Address: Words 13,14 determine the starting address in the remote PLC from which the data is to be read. The value entered is the 32-bit offset (1-based) from the beginning of PLC memory for the memory type and mode specified in Word 12. Word 13 contains the least significant 16 bits of the offset; word 14 contains the most significant 16 bits of the offset. This offset will be either in bits, bytes, or words depending on the mode specified (for example, if Word 12=16 and Words 13,14 =9, 0, then the starting address will be %I65). Valid ranges of values depend on the remote PLC's memory ranges.

(Word 15) Remote PLC - Number of Memory Units: Word 15 specifies the amount of data to be transferred. The value entered is the number of memory units to be transferred, where the size of the remote PLC memory type (bit, byte, or word) is specified in Word 12. For example, if Word 12=16 and Word 15=4, then 4 bytes (32 bits) of %I memory will be transferred. For Read PLC Memory, the maximum length is 11200 bits, 1400 bytes, or 700 words of data.

(Word 16) Remote PLC - Network Address Type: Word 16 specifies the format of the remote PLC address. Word 16 must contain the value 1. This indicates a dotted-decimal IP address expressed using a separate register for each decimal digit.

(Word 17) Remote PLC - Network Address Length: Word 17 specifies the length in words of the remote PLC IP address in this COMMREQ Command Block. Word 17 must contain 4.

(Words 18 – 21) Remote PLC - IP Address: Words 18–21 specify the four integers, one integer per word, of the dotted-decimal IP address of the remote PLC to be accessed.

(Word 22) Remote PLC – Password Length: Word 22 specifies the number of characters, including the NULL termination character, in the optional password field of this COMMREQ Command Block. For PACSystems PLC targets, the password may be at most 7 characters plus the terminating NULL character. Other target devices may support longer passwords. In no case may the password be larger than 254 characters. If a password is not included, word 22 must be set to 0.

(Words 23 …) Remote PLC – Password (Optional): Words 23 through the end of the COMMREQ Command Block specify an optional password string to be passed to the remote PLC. The password string is a case-sensitive string of ASCII characters and must be terminated with the NULL character.

Note

The Password must have each pair of ASCII characters reversed within the PLC memory. For example, the password string "MARY" ("M" = 4DH, "A" = 41H, "R" = 52H, "Y" = 59H) would have 414DH in the first word, 5952H in the second word, and 0000H in the third word (the terminating NULL character) The password length in Word 22 would be 0005H.

Write PLC Memory (4001)

The Write PLC Memory command can be used to write memory locations to one remote PACSystems PLC. Use of this command does not require a configured produced / consumed exchange in the PLCs.

Write PLC Memory Command Block

Word Offset	Value	Description
Word 1	Length of command data block, including optional password data	16 plus optional password data size in Word 22.
Word 2	0	Always 0 (no-wait mode request)
Word 3	(See table on page 5-3)	Memory type of COMMREQ Status Word
Word 4	0-based.	Offset of COMMREQ Status Word
Word 5	0	Reserved
Word 6	0	Reserved
Word 7	4001 (fa1H)	Write PLC Memory command number.
Word 8	Timeout, in milliseconds	The maximum time to wait for a response, in 10-millisecond increments. Default is 1000ms. A timeout must be specified. If 0 is entered, the default of 1000ms is used.
Word 9	Local write buffer memory type	Memory type for the data that will be written, in the local PLC.
Word 10, Word 11	Local write buffer reference table starting address	1-based offset in the local PLC.
Word 12	Remote write location memory type	Memory type into which data will be written in the remote PLC(s)
Word 13, Word 14	Remote reference table write location starting address	1-based offset in the remote PLC
Word 15	Write Length	0 to 1400 bytes, 0 to 700 words.
Word 16	Network address type	Must be 1. Indicates an IP address will be used.
Word 17	Network address length	Must be 4 for IP address. Group ID (multicast) is not permitted.
Word 18 – Word 21	IP Address of the remote PLC	Four integers, specified as one integer per word of the dotted-decimal IP address of the remote PLC. May not be a group IP address.
Word 22	Password length, required	Number of characters in the password, including the NULL termination character. Must be set to 0 if a password is not included.
Word 23 – end	Password, optional	NULL terminated. This is the optional password that may be required to access the remote PLC.

* Word 4 (CRS word address) is the only zero-based address in the Command Block. Only this value requires subtracting 1 from the intended address.

(Word 7) EGD Command Number: Word 7 requests that a write PLC memory operation occur. If the command is processed successfully, it will result in PLC reference memory data being sent from the server to the client.

(Word 8) Write Command Timeout: Word 8 specifies the time (in milliseconds) that the Ethernet Interface will wait for the command to complete before returning an error status in the COMMREQ status word. If the timeout value is specified as zero, no timeout error will be reported.

(Word 9) Local PLC - Memory Type: Words 9-11 specify the location in the local PLC where the Ethernet Interface will get the data to be written to the remote PLC. Valid values for Word 9 are listed in the description of Read PLC Memory Command. The amount of data to be transferred is specified by the number of memory units of the data written to the remote PLC (Word 15).

(Words 10 - 11) Local PLC - Memory Starting Address: Words 10 and 11 determine the starting address in the local PLC from which the data is to be written to the remote PLC. The value entered is the 32-bit offset (1-based) from the beginning of PLC memory for the memory type and mode specified in Word 9. Word 10 contains the least significant 16 bits of the offset; word 11 contains the most significant 16 bits of the offset. This offset will be either in bits, bytes, or words depending on the mode specified. (For example, if Word 9=16 and Words 10,11 = 2, 0 then the starting address will be %I9.) Valid ranges of values depend on the PLC's memory ranges.

(Word 12) Remote PLC - Memory Type: Words 12–14 specify the memory type and starting address in the remote PLC where data is to be written. Valid values for Word 12 are listed above.

(Words 13 - 14) Remote PLC - Memory Starting Address: Words 13,14 determine the starting address in the remote PLC where data is to be written. The value entered is the 32-bit offset (1-based) from the beginning of PLC memory for the memory type and mode specified in Word 12. Word 13 contains the least significant 16 bits of the offset; word 14 contains the most significant 16 bits of the offset. This offset will be either in bits, bytes, or words depending on the mode specified (for example, if Word 12=16 and Words 13,14 =9, 0, then the starting address will be %I65). Valid ranges of values depend on the remote PLC's memory ranges.

(Word 15) Remote PLC - Number of Memory Units: Word 15 specifies the amount of data to be transferred. The value entered is the number of memory units to be transferred, where the size of the remote PLC memory type (bit, byte, or word) is specified in Word 12. For example, if Word 12=16 and Word 15=4, then 4 bytes (32 bits) of %I memory will be transferred. For Write PLC Memory, the maximum length is 11200 bits, 1400 bytes, or 700 words of data. If a password is specified, the data length is decreased by the password length plus 8 bytes.

(Word 16) Remote PLC - Network Address Type: Word 16 specifies the format of the remote PLC address. Word 16 must contain the value 1. This indicates a dotted-decimal IP address expressed using a separate register for each decimal digit.

(Word 17) Remote PLC - Network Address Length: Word 17 specifies the length in words of the remote PLC IP address in this COMMREQ Command Block. Word 17 must contain 4.

(Words 18 – 21) Remote PLC - IP Address: Words 18–21 specify the four integers, one integer per word, of the dotted-decimal IP address of the remote PLC to be accessed.

(Word 22) Remote PLC – Password Length: Word 22 specifies the number of characters, including the NULL termination character, in the optional password field of this COMMREQ Command Block. For PACSystems PLC targets, the password may be at most 7 characters plus the terminating NULL. Other target devices may support longer passwords. In no case may the password be larger than 254 characters. If a password is not included, word 22 must be set to 0.

(Words 23 …) Remote PLC – Password (Optional): Words 23 through the end of the COMMREQ Command Block specify an optional password string to be passed to the remote PLC. The password string is a case-sensitive string of ASCII characters and must be terminated with the NULL character.

Note

The Password must have each pair of ASCII characters reversed within the PLC memory. For example, the password string “MARY” (“M” = 4DH, “A” = 41H, “R” = 52H, “Y” = 59H) would have 414DH in the first word, 5952H in the second word , and 0000H in the third word (the terminating NULL character) The password length in Word 22 would be 0005H.

Read EGD Exchange (4002)

The Read EGD Exchange command can be used to read some or all of a configured Ethernet Global Data exchange from either the producer or the consumer. This command identifies the data to be read using its configured Producer ID and Exchange ID. It can then read the content of the data for the exchange, directly from the producer or consumer device memory. This command can be sent to PACSystems PLCs and to other EGD Class 2 devices. In a PACSystems PLC, reading an EGD exchange reads the PLC reference memory locations configured to be transferred at the specified offset in the exchange. Thus current process data will be read, not the data that was transferred last in the exchange.

Read EGD Exchange Command Block

Word Offset	Value	Description
Word 1	Length of command data block, including optional password data	19 plus optional password data size in Word 25.
Word 2	0	Always 0 (no-wait mode request)
Word 3	(See table on page 5-3)	Memory type of COMMREQ Status Word
Word 4	0-based.	Offset of COMMREQ Status Word
Word 5	0	Reserved
Word 6	0	Reserved
Word 7	4002 (fa2H)	Read EGD Exchange command number.
Word 8	Timeout, in milliseconds	The maximum time to wait for a response, in 10-millisecond increments. Default is 1000ms. A timeout must be specified. If 0 is entered, the default of 1000ms is used.
Word 9	Local read buffer memory type	Memory type for the data, in the local PLC.
Word 10, 11	Local read buffer reference table starting address	1-based offset
Word 12	Remote signature	EGD Exchange signature. This should be 0 for PLCs.
Word 13, 14	Remote Producer ID	EGD Producer ID
Word 15, 16	Remote Exchange ID	EGD Exchange ID
Word 17	Remote Exchange Offset	Byte offset (0-based) in the exchange that should be read.
Word 18	Read length	Number of bytes to be read in the range 0 to 1400 bytes.
Word 19	Network address type	Must be 1. Indicates that an IP address will be used.
Word 20	Network address length	Must be 4 for IP address. Group ID (multicast) is not permitted.
Word 21 to Word 24	IP Address of the remote PLC	Four integers, specified as one integer per word of the dotted-decimal IP address of the remote PLC. May not be a group IP address.
Word 25	Password length, required	Number of characters in the password, including the NULL termination character. Must be set to 0 if a password is not included.
Word 26 – end	Password, optional	NULL terminated. This is the optional password that may be required to access the remote PLC.

* Word 4 (COMMREQ status word address) is the only zero-based address in the Command Block. Only this value requires subtracting 1 from the intended address.

(Word 7) EGD Command Number: Word 7 requests that a read EGD exchange operation occur. If the command is processed successfully, it will result in data from a specified EGD exchange being read from the client to the server.

(Word 8) Read Command Timeout: Word 8 specifies the time (in milliseconds) that the Ethernet Interface will wait for the command to complete before returning an error status in the COMMREQ status word. If the timeout value is specified as zero, a timeout of 1000 msec (= 1.000 sec) is used.

(Word 9) Local PLC - Memory Type: Words 9-11 specify the location in the local PLC where the Ethernet Interface will get the data to be read from the remote EGD device. Valid values for Word 9 are listed in the description of Read PLC Memory Command. The amount of data to be transferred is specified by the Exchange Data Length (Word 18).

(Words 10 - 11) Local PLC - Memory Starting Address: Words 10 and 11 determine the starting address in the local PLC where data is to be read from the remote EGD exchange. The value entered is the 32-bit offset (1-based) from the beginning of PLC memory for the memory type and mode specified in Word 9. Word 10 contains the least significant 16 bits of the offset; word 11 contains the most significant 16 bits of the offset. This offset will be either in bits, bytes, or words depending on the mode specified. (For example, if Word 9=16 and Words 10,11 = 2, 0 then the starting address will be %I9.) Valid ranges of values depend on the PLC's memory ranges. The user is responsible for assuring that this area is large enough to contain the requested data without overwriting other application data.

(Word 12) Remote EGD exchange – Exchange Signature: Words 12 contains the 16-bit exchange signature value to be compared at the remote EGD device. For remote PLC's, the exchange signature should ordinarily be set to 0.

(Words 13 - 14) Remote EGD exchange – Producer ID: Words 13 and 14 contains the 32-bit Producer ID of the desired exchange at the remote EGD device. Word 13 contains the least significant 16 bits of the Producer ID; word 14 contains the most significant 16 bits.

(Words 15 - 16) Remote EGD exchange – Exchange ID: Words 15 and 16 contains the 32-bit Exchange ID of the desired exchange at the remote EGD device. Word 15 contains the least significant 16 bits of the Exchange ID; word 16 contains the most significant 16 bits.

(Word 17) Remote EGD exchange – Exchange Data Offset: Word 17 contains the 0-based byte offset of the data to be read from the data portion of the exchange at the remote EGD device.

(Word 18) Remote EGD exchange – Exchange Data Length: Word 18 contains the length (in bytes) of the exchange data to be read from the remote EGD device. The exchange data length may not exceed 1400 bytes.

(Word 19) Remote PLC - Network Address Type: Word 19 specifies the format of the remote PLC address. Word 19 must contain the value 1. This indicates a dotted-decimal IP address expressed using a separate register for each decimal digit.

(Word 20) Remote PLC - Network Address Length: Word 20 specifies the length in words of the remote PLC IP address in this COMMREQ Command Block. Word 20 must contain 4.

(Words 21 – 24) Remote PLC - IP Address: Words 21–24 specify the four integers, one integer per word, of the dotted-decimal IP address of the remote PLC to be accessed.

(Word 25) Remote PLC – Password Length: Word 25 specifies the number of characters, including the NULL termination character, in the optional password field of this COMMREQ Command Block. For PACSystems PLC targets, the password may be at most 7 characters plus the terminating NULL character. Other target devices may support longer passwords. In no case may the password be larger than 254 characters. If a password is not included, word 25 must be set to 0.

(Words 26 …) Remote PLC – Password (Optional): Words 26 through the end of the COMMREQ Command Block specify an optional password string to be passed to the remote PLC. The password string is a case-sensitive string of ASCII characters and must be terminated with the NULL character.

Note

The Password must have each pair of ASCII characters reversed within the PLC memory. For example, the password string “MARY” (“M” = 4DH, “A” = 41H, “R” = 52H, “Y” = 59H) would have 414DH in the first word, 5952H in the second word , and 0000H in the third word (the terminating NULL character) The password length in Word 22 would be 0005H.

Write EGD Exchange (4003)

The Write EGD Exchange command can be used to write portions of a configured Ethernet Global Data exchange in a remote producer node. EGD protocol prohibits writing to a consumed exchange. . This command identifies the exchange to be written using its configured Producer ID and Exchange ID. It can then write the content of that data directly to the device memory. This command can be sent to PACSystems PLCs and to other EGD Class 2 devices. In a PACSystems PLC, writing an EGD exchange modifies the PLC reference memory locations configured for transfer at the specified offset in the exchange. Thus current process data will be updated, not the data that was transferred last in the exchange.

Write EGD Exchange Command Block

Word Offset	Value	Description
Word 1	Length of command data block, including optional password data	19 plus optional password data size in Word 25.
Word 2	0	Always 0 (no-wait mode request)
Word 3	(See table on page 5-3)	Memory type of COMMREQ Status Word
Word 4	0-based.	Offset of COMMREQ Status Word
Word 5	0	Reserved
Word 6	0	Reserved
Word 7	4003 (fa3H)	Write EGD Exchange command number.
Word 8	Timeout, in milliseconds	The maximum time to wait for a response, in 10-millisecond increments. Default is 1000ms. A timeout must be specified. If 0 is entered, the default of 1000ms is used.
Word 9	Local write buffer memory type	Memory type for the data, in the local PLC.
Word 10, Word 11	Local write buffer reference table starting address	1-based offset
Word 12	Remote signature	EGD Exchange signature. This should be 0 for PLCs.
Word 13, Word 14	Remote Producer ID	EGD Producer ID
Word 15, Word 16	Remote Exchange ID	EGD Exchange ID
Word 17	Remote Exchange Offset	Byte offset (0-based) in the exchange that should be read.
Word 18	Write length	Number of bytes to be written in the range 0 to 1400 bytes.
Word 19	Network address type	Must be 1. Indicates an IP address will be used.
Word 20	Network address length	Must be 4 for IP address. Group ID (multicast) is not permitted.
Word 21 to Word 24	IP Address of the remote PLC	Four integers, specified as one integer per word of the dotted-decimal IP address of the remote PLC. May not be a group IP address.
Word 25	Password length, required	Number of characters in the password, including the NULL termination character. Must be set to 0 if a password is not included.
Word 26 – end	Password, optional	NULL terminated. This is the optional password that may be required to access the remote PLC.

* Word 4 (COMMREQ status word address) is the only zero-based address in the Command Block. Only this value requires subtracting 1 from the intended address.

(Word 7) EGD Command Number: Word 7 requests that a write EGD exchange operation occur. If the command is processed successfully, it will result in data for a specified EGD exchange being written from the client to the server.

(Word 8) Write Command Timeout: Word 8 specifies the time (in milliseconds) that the Ethernet Interface will wait for the command to complete before returning an error status in the COMMREQ status word. If the timeout value is specified as zero, a timeout of 1000 msec (= 1.000 sec) is used.

(Word 9) Local PLC - Memory Type: Words 9-11 specify the location in the local PLC where the Ethernet Interface will get the data to write to the remote EGD device. Valid values for Word 9 are listed in the description of Read PLC Memory Command. The amount of data to be transferred is specified by the Exchange Data Length (Word 18).

(Words 10 - 11) Local PLC - Memory Starting Address: Words 10 and 11 determine the starting address in the local PLC from which data is to be written to the remote EGD exchange. The value entered is the 32-bit offset (1-based) from the beginning of PLC memory for the memory type and mode specified in Word 9. Word 10 contains the least significant 16 bits of the offset; word 11 contains the most significant 16 bits of the offset. This offset will be either in bits, bytes, or words depending on the mode specified. (For example, if Word 9=16 and Words 10,11 = 2, 0 then the starting address will be %I9.) Valid ranges of values depend on the PLC's memory ranges.

(Word 12) Remote EGD exchange – Exchange Signature: Words 12 contains the 16-bit exchange signature value to be compared at the remote EGD device. For remote PLC's, the exchange signature should ordinarily be set to 0.

(Words 13 - 14) Remote EGD exchange – Producer ID: Words 13 and 14 contains the 32-bit Producer ID of the desired exchange at the remote EGD device. Word 13 contains the least significant 16 bits of the Producer ID; word 14 contains the most significant 16 bits.

(Words 15 - 16) Remote EGD exchange – Exchange ID: Words 15 and 16 contains the 32-bit Exchange ID of the desired exchange at the remote EGD device. Word 15 contains the least significant 16 bits of the Exchange ID; word 16 contains the most significant 16 bits. For the Write EGD Command, the exchange at the remote device must be a Produced exchange.

(Word 17) Remote EGD exchange – Exchange Data Offset: Word 17 contains the 0-based byte offset of the data to be overwritten in the data portion of the exchange at the remote EGD device.

(Word 18) Remote EGD exchange – Exchange Data Length: Word 18 contains the length (in bytes) of the exchange data to be written to the remote EGD device. The exchange data length may not exceed 1400 bytes.

(Word 19) Remote PLC - Network Address Type: Word 19 specifies the format of the remote PLC address. Word 19 must contain the value 1. This indicates a dotted-decimal IP address expressed using a separate register for each decimal digit.

(Word 20) Remote PLC - Network Address Length: Word 20 specifies the length in words of the remote PLC IP address in this COMMREQ Command Block. Word 20 must contain 4.

(Words 21 – 24) Remote PLC - IP Address: Words 21–24 specify the four integers, one integer per word, of the dotted-decimal IP address of the remote PLC to be accessed.

(Word 25) Remote PLC – Password Length: Word 25 specifies the number of characters, including the NULL termination character, in the optional password field of this COMMREQ Command Block. For PACSystems PLC targets, the password may be at most 7 characters plus the terminating NULL character. Other target devices may support longer passwords. In no case may the password be larger than 254 characters. If a password is not included, word 25 must be set to 0.

(Words 26 …) Remote PLC – Password (Optional): Words 26 through the end of the COMMREQ Command Block specify an optional password string to be passed to the remote PLC. The password string is a case-sensitive string of ASCII characters and must be terminated with the NULL character.

Note

The Password must have each pair of ASCII characters reversed within the PLC memory. For example, the password string “MARY” (“M” = 4DH, “A” = 41H, “R” = 52H, “Y” = 59H) would have 414DH in the first word, 5952H in the second word , and 0000H in the third word (the terminating NULL character) The password length in Word 22 would be 0005H.

Masked Write to EGD Exchange (4004)

The Masked Write to EGD Exchange command can be used to write one or more bits in a single byte of a configured Ethernet Global Data exchange in a remote producer node. EGD protocol prohibits writing to a consumed exchange. This command can be sent to PACSystems PLCs and to other EGD Class 2 devices.

In a PACSystems PLC, writing an EGD exchange modifies the PLC reference memory locations configured to be transferred at the specified offset in the exchange. Thus current process data will be updated, not the data that was transferred last in the exchange.

Masked Write EGD Exchange Command Block

Word Offset	Value	Description
Word 1	Length of command data block, including optional password data	17 plus optional password data size in Word 23.
Word 2	0	Always 0 (no-wait mode request)
Word 3	(See table on page 5-3)	Memory type of COMMREQ Status Word
Word 4	0-based.	Offset of COMMREQ Status Word
Word 5	0	Reserved
Word 6	0	Reserved
Word 7	4004 (fa4H)	Masked Write to EGD Exchange command number.
Word 8	Timeout, in milliseconds	The maximum time to wait for a response, in 10-millisecond increments. Default is 1000ms. A timeout must be specified. If 0 is entered, the default of 1000ms is used.
Word 9	Bit mask, set bit to be written to 1, rest to 0	The bit mask selects the individual bit to be written. The most significant bytes of Word 9 and Word 10 are ignored.
Word 10	Write 0 or 1 to selected bit.	Value to set the bit selected by the bit mask in Word 9.
Word 11	Remote signature	EGD Exchange signature. This should be 0 for PLCs.
Word 12, 13	Remote Producer ID	EGD Producer ID
Word 14, 15	Remote Exchange ID	EGD Exchange ID
Word 16	Remote Exchange Offset	Byte offset (0-based) in the exchange that should be read.
Word 17	Network address type	Must be 1. Indicates an IP address will be used.
Word 18	Network address length	Must be 4 for IP address. Group ID (multicast) is not permitted.
Word 19 to Word 22	IP Address of the remote PLC	Four integers, specified as one integer per word of the dotted-decimal IP address of the remote PLC. May not be a group IP address.
Word 23	Password length, required	Number of characters in the password, including the NULL termination character. Must be set to 0 if a password is not included.
Word 24 – end	Password, optional	NULL terminated. This is the optional password that may be required to access the remote PLC.

* Word 4 (COMMREQ status word address) is the only zero-based address in the Command Block. Only this value requires subtracting 1 from the intended address.

(Word 7) EGD Command Number: Word 7 requests that a masked write EGD exchange operation occur. If the command is processed successfully, it will result in a data bit for a specified EGD exchange being written from the client to the server.

(Word 8) Masked Write Command Timeout: Word 8 specifies the time (in milliseconds) that the Ethernet Interface will wait for the command to complete before returning an error status in the COMMREQ status word. If the timeout value is specified as zero, a timeout of 1000 msec (= 1.000 sec) is used.

(Word 9) Bit Mask: Words 9 – 10 specify the individual data to be written to the remote EGD exchange. The usage of the Bit Mask and Data are described in *Masked Write to EGD Exchange Bit Mask and Data Bits*, below. Word 9 contains a bit mask that identifies a bit or bits within a data byte. The mask bit corresponding to each data bit to be written is set to 1; all other bits are set to 0.

(Word 10) Data: Word 10 contains the data byte that contains the bit or bits to be written to the remote EGD exchange. The individual data bits to be written are in the same position as the 1 bits in the Bit Mask (Word 9).

(Word 11) Remote EGD exchange – Exchange Signature: Words 11 contains the 16-bit exchange signature value to be compared at the remote EGD device. For remote PLC's, the exchange signature should ordinarily be set to 0.

(Words 12 - 13) Remote EGD exchange – Producer ID: Words 12 and 13 contains the 32-bit Producer ID of the desired exchange at the remote EGD device. Word 12 contains the least significant 16 bits of the Producer ID; word 13 contains the most significant 16 bits.

(Words 14 - 15) Remote EGD exchange – Exchange ID: Words 14 and 15 contains the 32-bit Exchange ID of the desired exchange at the remote EGD device. Word 14 contains the least significant 16 bits of the Exchange ID; word 15 contains the most significant 16 bits. For the Masked Write EGD Command, the exchange at the remote device must be a Produced exchange.

(Word 16) Remote EGD exchange – Exchange Data Offset: Word 16 contains the 0-based byte offset of the single data byte data containing the bit or bits to be overwritten in the data portion of the exchange at the remote EGD device.

(Word 17) Remote PLC - Network Address Type: Word 17 specifies the format of the remote PLC address. Word 17 must contain the value 1. This indicates a dotted-decimal IP address expressed using a separate register for each decimal digit.

(Word 18) Remote PLC - Network Address Length: Word 18 specifies the length in words of the remote PLC IP address in this COMMREQ Command Block. Word 18 must contain 4.

(Words 19 – 22) Remote PLC - IP Address: Words 19–22 specify the four integers, one integer per word, of the dotted-decimal IP address of the remote PLC to be accessed.

(Word 23) Remote PLC – Password Length: Word 23 specifies the number of characters, including the NULL termination character, in the optional password field of this COMMREQ Command Block. For PACSystems PLC targets, the password may be at most 7 characters plus the terminating NULL character. Other target devices may support longer passwords. In no case may the password be larger than 254 characters. If a password is not included, word 23 must be set to 0.

(Words 24 …) Remote PLC – Password: Words 24 through the end of the COMMREQ Command Block specify an optional password string to be passed to the remote PLC. The password string is a case-sensitive string of ASCII characters and must be terminated with the NULL character.

Note

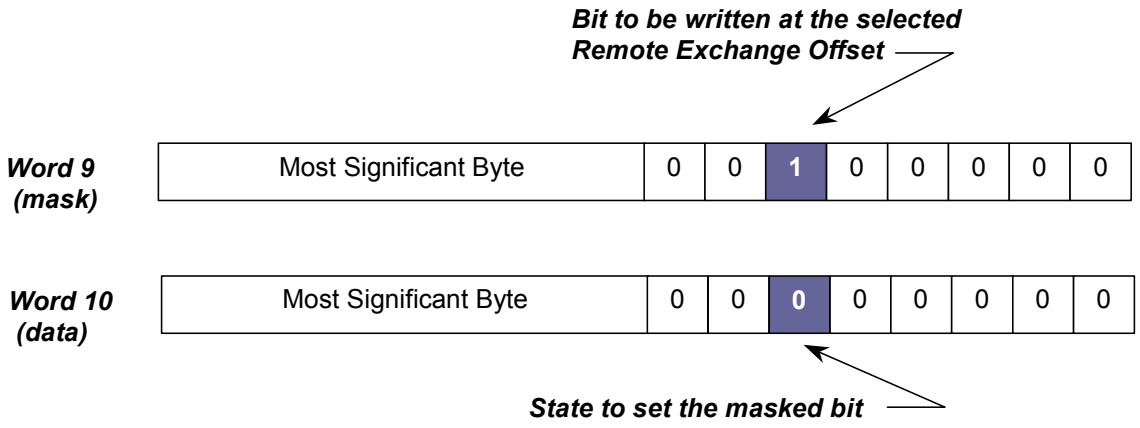
The Password must have each pair of ASCII characters reversed within the PLC memory. For example, the password string “MARY” (“M” = 4DH, “A” = 41H, “R” = 52H, “Y” = 59H) would have 414DH in the first word, 5952H in the second word , and 0000H in the third word (the terminating NULL character) The password length in Word 22 would be 0005H.

Masked Write to EGD Exchange Bit Mask and Data Bits

Word 9 of the Masked Write command contains the bit mask. The most significant byte of Word 9 is ignored. In the least significant byte, any bits set to 1 will be written to the remote producer.

The equivalent bit of Word 10 of the Masked Write command contains the bit state to be written, 1 or 0. The most significant byte of Word 10 is also ignored.

For example:


Bit to be written at the selected
Remote Exchange Offset
Word 9
(mask)
Most Significant Byte
0 0 1 0 0 0 0 0
Word 10
(data)
Most Significant Byte
0 0 0 0 0 0 0 0
State to set the masked bit

Chapter 6 Network Administration

This chapter discusses how devices are identified on the network and how data is routed among devices. The main topics covered are:

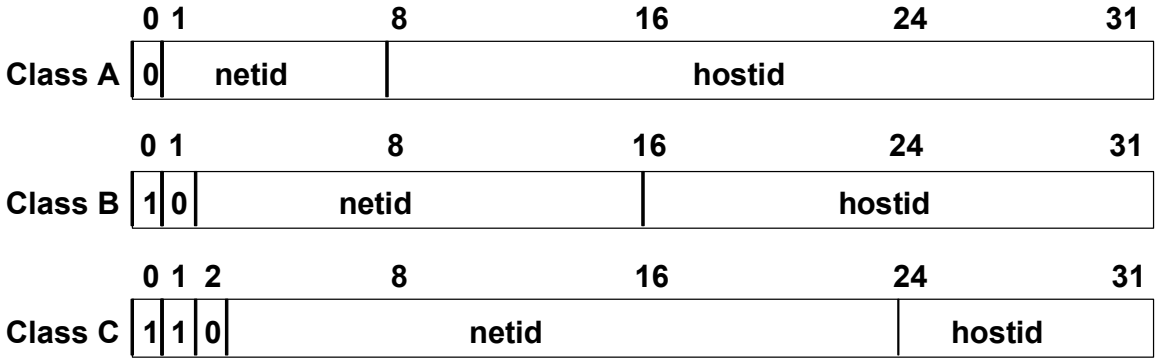
- IP Addressing
- Gateways
- Subnets

IP Addressing

Each TCP/IP node on a network must have a unique IP address. The PLC Ethernet Interface is such a node, as is a PC running TCP/IP. There may be other nodes on the network that are not involved with communications to the PLCs, but no matter what their function, each TCP/IP node must have its own unique IP address. It is the IP address that identifies each node on the IP network (or system of connected networks). The term “host” is often used to refer to a node on a network.

IP Address Format for Network Classes A, B, C

The *IP address* is 32 bits long and has a *netid* part and a *hostid* part. Each network is a Class A, Class B or Class C network. The class of a network determines how an IP address is formatted and is based on the number of bits in the netid part of the IP address.



In general, the netid part is assigned by the Internet authorities and the hostid part is assigned by your local network administrator. The class of network determines the number of hosts that can be supported. A Class A network can support 2^{24}-2 (16,777,214) hosts, Class B, 2^{16}-2 (65,534) hosts, and Class C, 2^{8}-2 (254) hosts. The minus 2 refers to host numbers reserved for the network itself and the local broadcast.

Each node on the same physical network must have an IP address of the same class and must have the same netid. Each node on the same physical network must have a different hostid thus giving it a unique IP address.

IP addresses are written in “dotted-decimal” format as four decimal integers (0-255) separated by periods where each integer gives the value of one byte of the IP address. For example, the 32-bit IP address:

00001010 00000000 00000000 00000001

is written as

10.0.0.1

One can determine the class of an IP address by examining the first integer in its dotted-decimal IP address and comparing with the range of values in the following table.

Range of first integer	*Class*
0 - 127*	A
128 - 191	B
192 - 223	C
224-239	D (Reserved for Multicast Use)
240 - 255	E (Reserved for Experimental Use)

Note: The value 127 is reserved for loopback operation.

IP Addresses Reserved for Private Networks

RFC 1918 reserves IP addresses in the following ranges to be used for private networks.

10.0.0.0 – 10.255.255.255 (Class A)
172.16.0.0 – 172.31.255.255 (Class B)
192.168.0.0 – 192.168.255.255 (Class C)

Multicast IP Addresses

Multicast IP Addresses are used in multicasting, a technique that allows delivery of a single packet of data to multiple nodes on the network. Any node that joins a Multicast group will respond to the Multicast IP address assigned to that group. Subsequently, any data sent to that Multicast IP address may be received by all nodes that are members of that Multicast group. Multicast (Class D) IP addresses (224.0.0.0 through 239.255.255.255) are reserved by the Internet authorities for multicasting.

Multicasting is a feature of Ethernet Global Data. For more information on the use of multicasting in Ethernet Global Data, see chapter 4.

Loopback IP Addresses

Loopback IP Addresses are used to locally process an outgoing packet as if it were received from the network. Note that packets using the loopback destination address are not actually transmitted to the network.

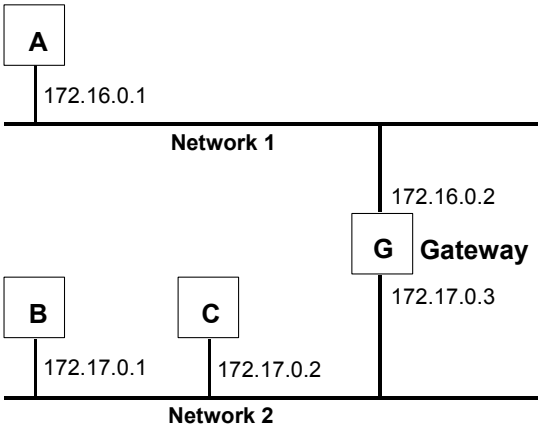
Although the Internet authorities reserve all IP addresses in the range 127.0.0.0 – 127.255.255.255 for loopback operation, the PACSystems Ethernet interface recognizes only IP address 127.0.0.1 as a local loopback IP address.

Gateways

Gateways (also known as routers) connect individual physical networks into a system of networks. When a node needs to communicate with a node on another physical network, a gateway transfers the data between the two networks.

Networks Connected by a Gateway

The following example shows Gateway G connecting Network 1 with Network 2.



When host B with IP address 172.17.0.1 communicates with host C, it knows from C's IP address that C is on the same network. In an Ethernet environment, B can then resolve C's IP address to a MAC address (via ARP) and communicate with C directly.

When host B communicates with host A, it knows from A's IP address that A is on another network (the *netids* are different). In order to send data to A, B must have the IP address of the gateway connecting the two networks. In this example, the gateway's IP address on Network 2 is 172.17.0.3. This address would be configured in the Ethernet Interface's module configuration for PLC B as its default gateway address.

Note that the gateway has two IP addresses (172.16.0.2 and 172.17.0.3). The first must be used by hosts on Network 1 and the second must be used by hosts on Network 2. To be usable, a host's gateway must be addressed using an IP address with a *netid* matching its own.

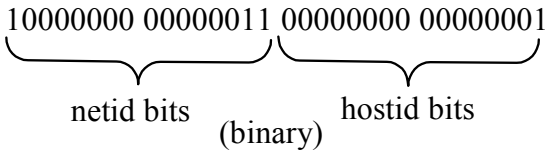
Subnets

Subnets allow a site's network administrators to divide a large network into several smaller networks while still presenting the overall network as one single entity to the outside world. Each of the site's interior gateways need only maintain the subnet numbers of other interior gateways instead of every single host on the entire network.

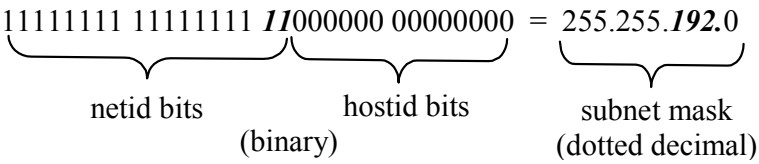
Subnet Addressing and Subnet Masks

Subnet addressing is an extension of the IP address scheme that allows a site to use a single netid for multiple physical networks. Routing outside the site continues as usual by dividing the IP address into a netid and a hostid via the class.

The standard format for the netid bits and hostid bits for an IP address in a Class B network is shown below.



Inside a site the *subnet mask* is used to re-divide the IP address into a custom netid portion and hostid portion. Consider adding another physical network to Network 2 (a Class B network) in the previous example. The result is shown in the figure below. Selecting the subnet mask shown below would add two additional *netid* bits allowing for four physical networks addressed as 0, 64, 128, and 192. The added subnet bits are normally taken from the *hostid bits* adjacent to the *netid* and the subnet mask identifies these bits.

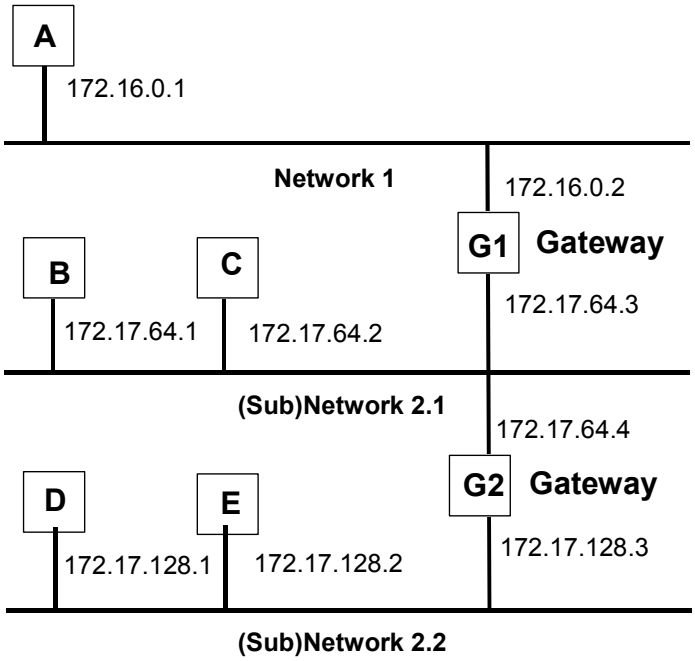


The bits in the subnet mask correspond one to one with the Internet address. The bits in the mask that are 1 treat the corresponding bits in the IP address as part of the *netid* bits. The bits in the mask that are 0 treat the corresponding bits as part of the *hostid* bits.

In effect, two bits of the Class B *hostid* have been used to extend the *netid,* creating an *extended netid*, or *subnetid*. Each unique combination of bits in the part of the *hostid* where subnet mask bits are 1 specifies a different physical network.

Example: Network Divided into Two Subnets

The new network configuration dividing Network 2 into Subnets 2.1 and 2.2 is shown below.



Here, a second network with Hosts D and E has been added. Gateway G2 connects Subnet 2.1 with Subnet 2.2. Hosts D and E will use Gateway G2 to communicate with hosts not on Network 2.2.

Hosts B and C will use Gateways G1 and G2 to communicate with hosts not on Network 2.1. When B is communicating with D, G2 (the configured Gateway for B) will route the data from B to D through Gateway G2.

Host A will use Gateway G1 to communicate with hosts not on Network 1.

Chapter 7 RX7i PLC Monitoring Via the Web

The PACSystems RX7i embedded CPU Ethernet Interface provides PLC data monitoring using a standard Web browser. Rack-based Ethernet modules do not support web server operation.

You can use the Web server to monitor the following PLC data:

- **PLC reference tables.** This data is a snapshot of the PLC Reference Tables when the data is displayed in the Browser and is not updated until you request another display. All reference tables are supported.
- **PLC and IO Fault Tables.**

The web server cannot be used to modify PLC data (acknowledge alarms, set/force values in tables).

The maximum number of web server connections that can be configured for the Ethernet Interface is 16. If the system includes FTP server connections, fewer web server connections are available, as explained in chapter 3, Configuration.

System Requirements

Web monitoring requires version 4.0 or later of Netscape Navigator or Internet Explorer. The browser must be capable of running the Java Virtual Machine (JVM) version 1.3 plug-in. The supported host operating systems are Windows NT 4.0 SP5 or SP6, Windows 95B, Windows 98 (First Edition Service Pack 1, Second Edition), and Windows 2000 Professional SP1, Windows Millennium Edition, Windows XP and Windows CE 3.0. To view the entire Reference Table page, the screen resolution must be 1024 x 768 or higher. Local web firewall blocking issues will be avoided by using HTTP protocol on port 80 to transfer standard HTML files including JavaScript and Java applets from the server to the browser and HTTP Post command to transfer form information from the browser to the server.

WEB Server Operation in a Redundant System

In a redundant system, only the active unit processes Web Server requests at the Redundant IP address and responds to web page requests. The backup unit does not respond to the Redundant IP address. When the active Ethernet interface changes to backup, it takes down all Web Server connections and their underlying TCP connections. The Web Server maintains its underlying TCP connection only long enough to process each web page request; a new TCP connection is opened, used, and closed for each subsequent web page display or update. Unless a web page change or update is requested during a redundancy switch, the operation of the Redundant IP address is transparent to the Web browser. Any web page request in process over the Redundant IP when a role switch occurs is ended.

Although both the active and backup units respond to Web server requests received at the direct IP address, having a remote (host) browser issue Web Server requests to the direct IP address is not recommended. Remote web browsers should use the Redundant IP address when communicating to a Redundant System.

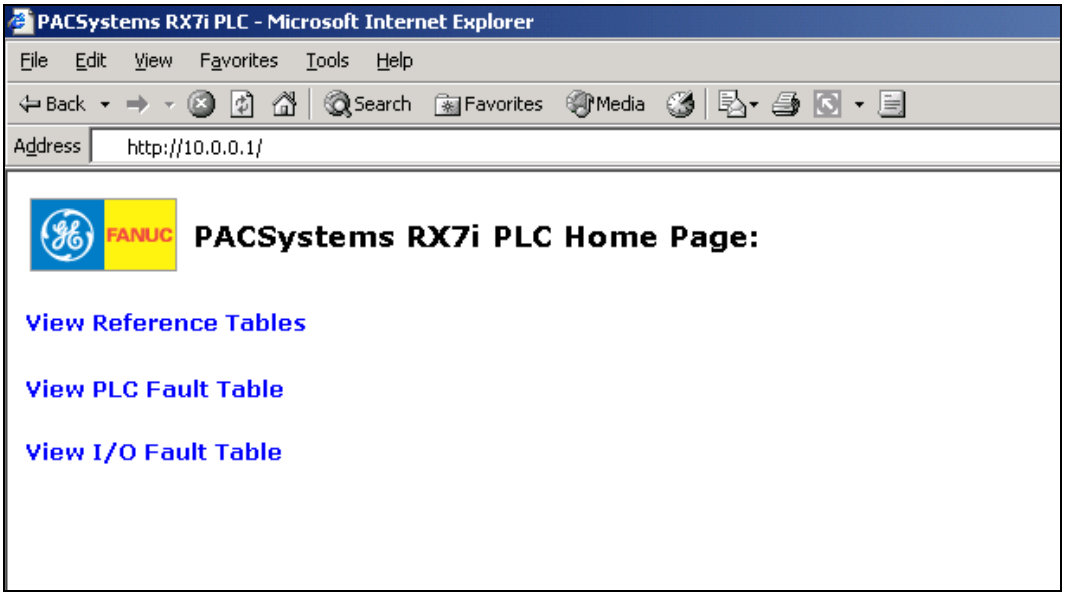
Standard Web Pages

The CPU Ethernet Interface is shipped with a set of standard PLC web pages already installed. These standard web pages include a PLC home page, a Reference Table display page, a PLC Fault Table display page, and an IO Fault Table display page.

When necessary, new or revised web page files may be transferred into the Ethernet Interface via the standard FTP protocol, as described later.

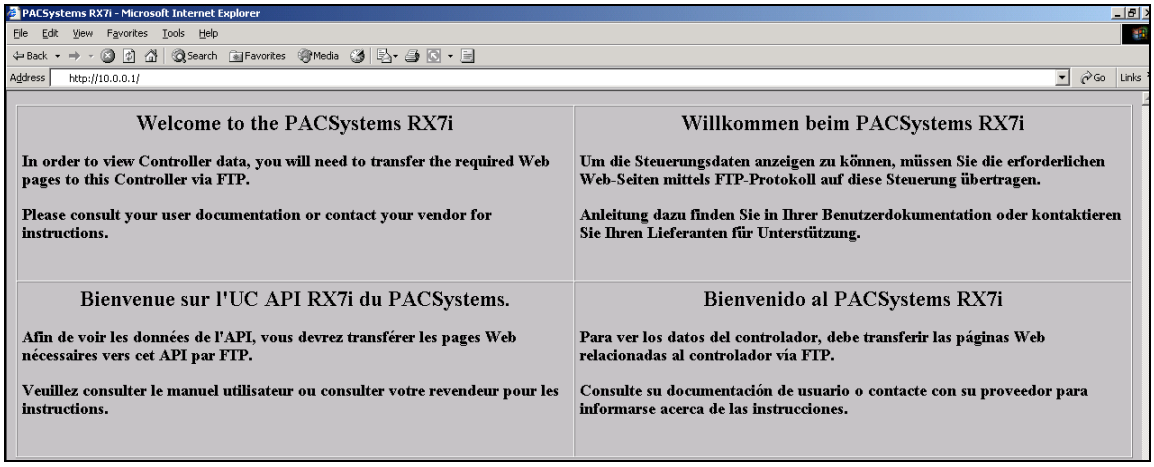
RX7i Home Page

The RX7i home page is displayed after entering the PLC CPU's URL or IP address at your web browser. From the PLC home page, you may navigate to the other PLC web pages.


PACSystems RX7i PLC - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://10.0.0.1/
FANUC
PACSystems RX7i PLC Home Page:
View Reference Tables
View PLC Fault Table
View I/O Fault Table

Factory Default Web Page

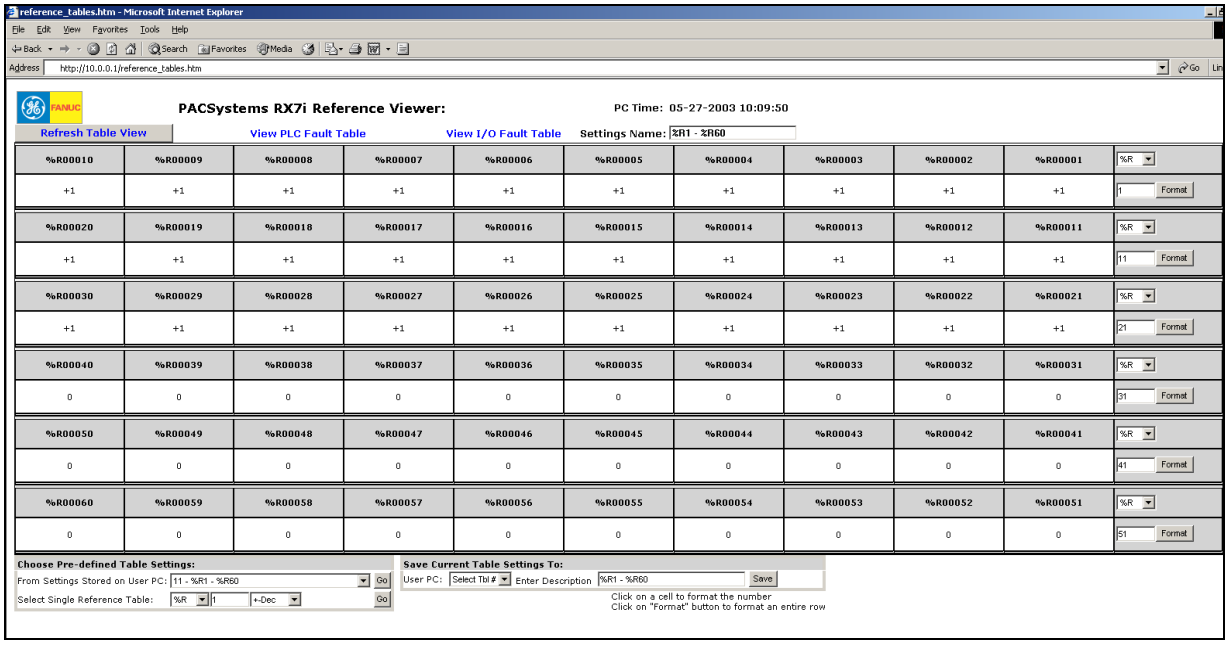
If the PLC home page file (index.htm) is not present in the Ethernet Interface file system, the web server instead displays the factory default web page.


PACSystems RX7i - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Address http://10.0.0.1/
Welcome to the PACSystems RX7i
In order to view Controller data, you will need to transfer the required Web pages to this Controller via FTP.
Please consult your user documentation or contact your vendor for instructions.
Willkommen beim PACSystems RX7i
Um die Steuerungsdaten anzeigen zu können, müssen Sie die erforderlichen Web-Seiten mittels FTP-Protokoll auf diese Steuerung übertragen.
Anleitung dazu finden Sie in Ihrer Benutzerdokumentation oder kontaktieren Sie Ihren Lieferanten für Unterstützung.
Bienvenue sur l'UC API RX7i du PACSystems.
Afin de voir les données de l'API, vous devrez transférer les pages Web nécessaires vers cet API par FTP.
Veuillez consulter le manuel utilisateur ou consulter votre revendeur pour les instructions.
Bienvenido al PACSystems RX7i
Para ver los datos del controlador, debe transferir las páginas Web relacionadas al controlador via FTP.
Consulte su documentación de usuario o contacte con su proveedor para informarse acerca de las instrucciones.

The default web page is displayed in English, French, German and Spanish if the browser is configured to use Western European encoding.

Reference Tables Viewer Page

The Reference Table s Viewer page shows the current states of a range of data references. This data is a snapshot of the PLC Reference Tables when the data was initially requested. It is NOT updated until you refresh the display. All RX7i reference tables are available.

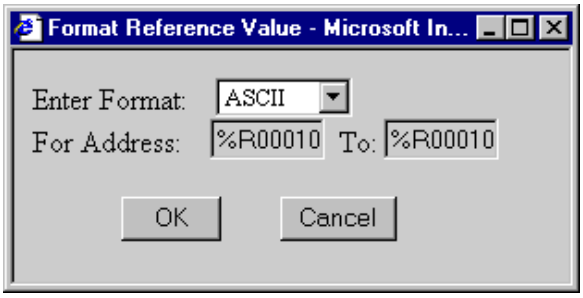

reference_tables.htm - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Address http://10.0.0.1/reference_tables.htm
PACSystems RX7i Reference Viewer:
PC Time: 05-27-2003 10:09:50
Refresh Table View
View PLC Fault Table
View I/O Fault Table
Settings Name: %R1 - %R60
%R00010 %R00009 %R00008 %R00007 %R00006 %R00005 %R00004 %R00003 %R00002 %R00001
+1 +1 +1 +1 +1 +1 +1 +1 +1 +1
%R00020 %R00019 %R00018 %R00017 %R00016 %R00015 %R00014 %R00013 %R00012 %R00011
+1 +1 +1 +1 +1 +1 +1 +1 +1 +1
%R00030 %R00029 %R00028 %R00027 %R00026 %R00025 %R00024 %R00023 %R00022 %R00021
+1 +1 +1 +1 +1 +1 +1 +1 +1 +1
%R00040 %R00039 %R00038 %R00037 %R00036 %R00035 %R00034 %R00033 %R00032 %R00031
0 0 0 0 0 0 0 0 0 0
%R00050 %R00049 %R00048 %R00047 %R00046 %R00045 %R00044 %R00043 %R00042 %R00041
0 0 0 0 0 0 0 0 0 0
%R00060 %R00059 %R00058 %R00057 %R00056 %R00055 %R00054 %R00053 %R00052 %R00051
0 0 0 0 0 0 0 0 0 0
%R
Format
Choose Pre-defined Table Settings:
From Settings Stored on User PC: 11 - %R1 - %R60 Go
Select Single Reference Table: %R 1 +-Dec Go
Save Current Table Settings To:
User PC: Select Tbl # Enter Description %R1 - %R60 Save
Click on a cell to format the number
Click on "Format" button to format an entire row

Selecting Reference Table Data

Initially, the previously-viewed reference table is displayed. To change the display, you can:

Select Reference Table Data Row-by-Row: The right column of each row contains the configuration options for that row. For each row, select the reference table, starting address, and data format. You can select the %R, %AI, %AQ, %I, %Q, %M, %T, %G, %S, %SA, %SB, %SC, %P, %L, or %W reference table. For %P and %L memory types, specify the logic program name, and for %L memory, the subroutine block name. The logic program and subroutine block names must be reentered when defining other rows.

To select the data format, click on a reference table address cell above the reference value and select the display format type. For example:



To format a row, click the Format button for the entire row. Use the drop down box to select the data format for the selected reference address or row. With Internet Explorer, pressing the "OK" button changes the format immediately. With Netscape, the format changes after you refresh the screen.

Saving Reference Table Settings

You can save up to 10 previously formatted reference table views on the computer being used to view the data. To save the current reference table settings, go to the section at the bottom of the page labeled 'Save Current Table Settings To:'. From the drop-down box, select a number to assign to these settings. Optionally, enter a description of the table settings by typing into the text box labeled 'Enter Description'. Click on the 'Save' button to save the reference table settings to the computer.

Display Formats

Binary: uses 1s and 0s to represent the bits in a byte or word of data. If a discrete bit is overridden for the %I, %Q, %M or %G tables, the bit is underlined.

+-Dec: signed decimal for one word of data. Valid range is –32768 to +32767.

Dec: unsigned decimal for one word of data. Valid range is 0 to 65535.

Hex: a four digit hexadecimal value for one word of data. The value has 16# as a prefix (for example 16#4241).Valid range is 16#0000 to 16#FFFF.

ASCII: ASCII representation of two 8-bit values. For example, a hex value of 16#4142 appears as “A B”. ASCII display requires Internet Explorer 4.0 or Netscape 4.7 or later.

+-DblDecimal: signed decimal for a double word (32 bits). Valid range is -2,147,483,648 to +2,147,483,647. This format is only available for word type memory (%R, %AI, % AQ, %P, %L, and %W).

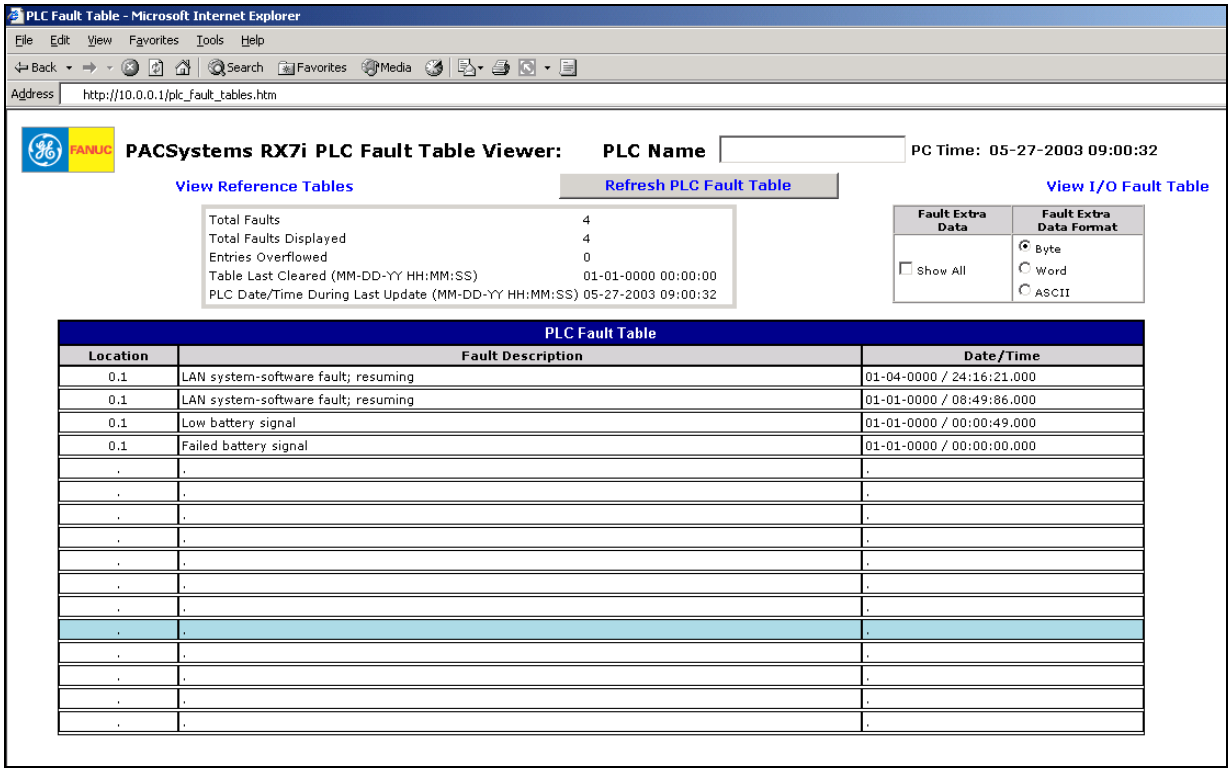
DblDecimal: unsigned decimal for a double word (32 bits). Valid range is 0 to 4,294,967,295. This format is only available for word type memory (%R, %AI, %AQ, %P, %L, and %W).

Real: 7 decimal digits plus a decimal point and exponent if necessary (for example 123.4567, 1.234567e+038). This format uses 2 words or 32 bits. This format is only available for word type memory (%R, %AI, %AQ, %P, %L, and %W). The range is +-1.401298e-045 to +-3.402823e+038.

Blank: The associated cell or row will have no value or reference address header.

PLC Fault Table Viewer Page

The PLC Fault Table Viewer displays the contents of the PLC fault table.


PLC Fault Table - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://10.0.0.1/plc_fault_tables.htm
PACSystems RX7i PLC Fault Table Viewer:
PLC Name
PC Time: 05-27-2003 09:00:32
View Reference Tables
Refresh PLC Fault Table
View I/O Fault Table
Total Faults 4
Total Faults Displayed 4
Entries Overflowed 0
Table Last Cleared (MM-DD-YY HH:MM:SS) 01-01-0000 00:00:00
PLC Date/Time During Last Update (MM-DD-YY HH:MM:SS) 05-27-2003 09:00:32
Fault Extra Data
Fault Extra Data Format
Show All
Byte
Word
ASCII
PLC Fault Table
Location
Fault Description
Date/Time
0.1 LAN system-software fault; resuming 01-04-0000 / 24:16:21.000
0.1 LAN system-software fault; resuming 01-01-0000 / 08:49:86.000
0.1 Low battery signal 01-01-0000 / 00:00:49.000
0.1 Failed battery signal 01-01-0000 / 00:00:00.000

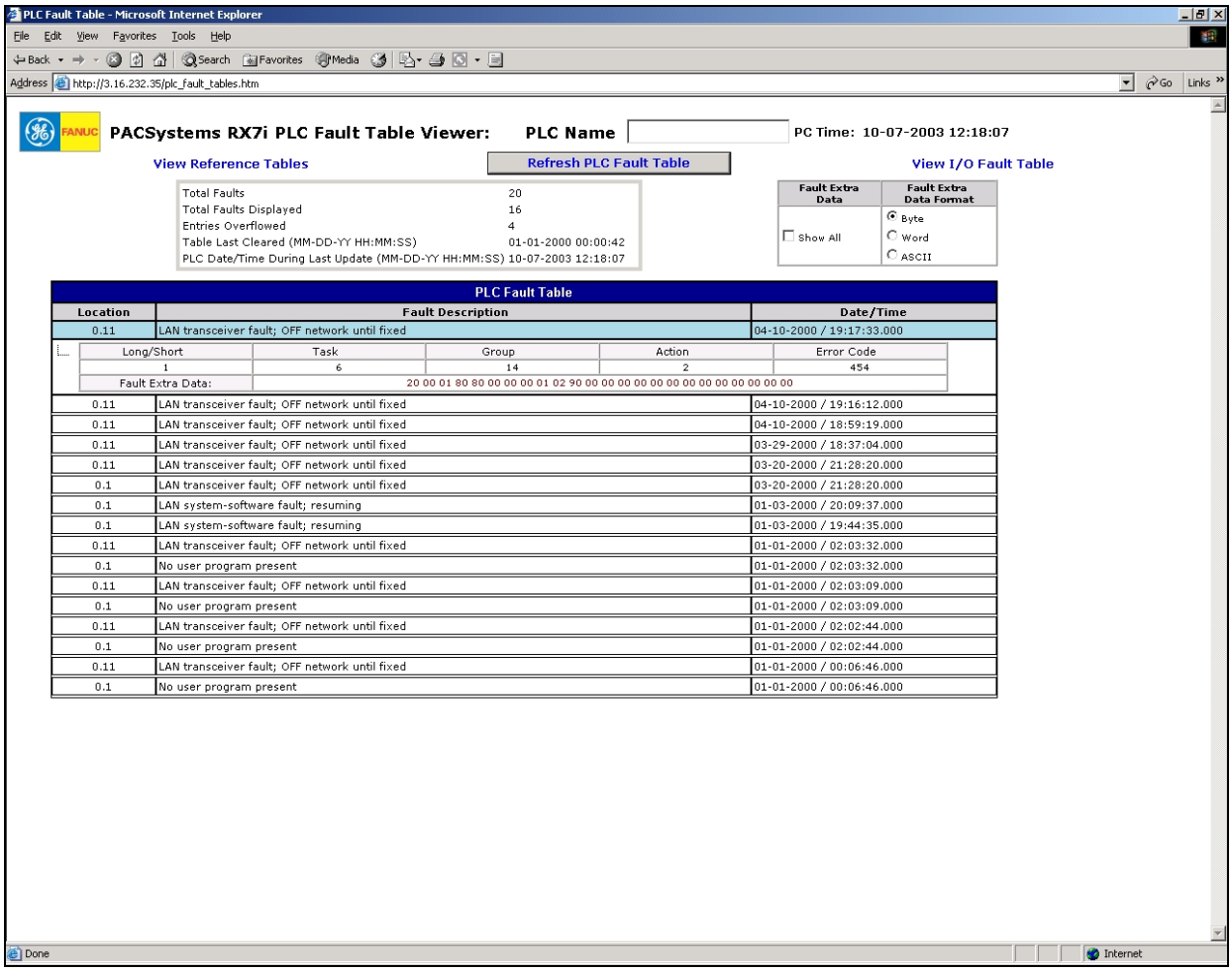
The PLC name is shown at the top of the page, together with the PLC timestamp showing when the page was accessed or refreshed.

The PLC fault table provides up to 16 entries arranged from newest to oldest. If there are fewer than 16 entries, the remaining rows are blank. If there are more than 16 faults, the table displays the most recent faults in the first 8 rows and the oldest faults in the last 8 rows.

To change the format of the fault extra data, select the appropriate checkbox at the top of the page.

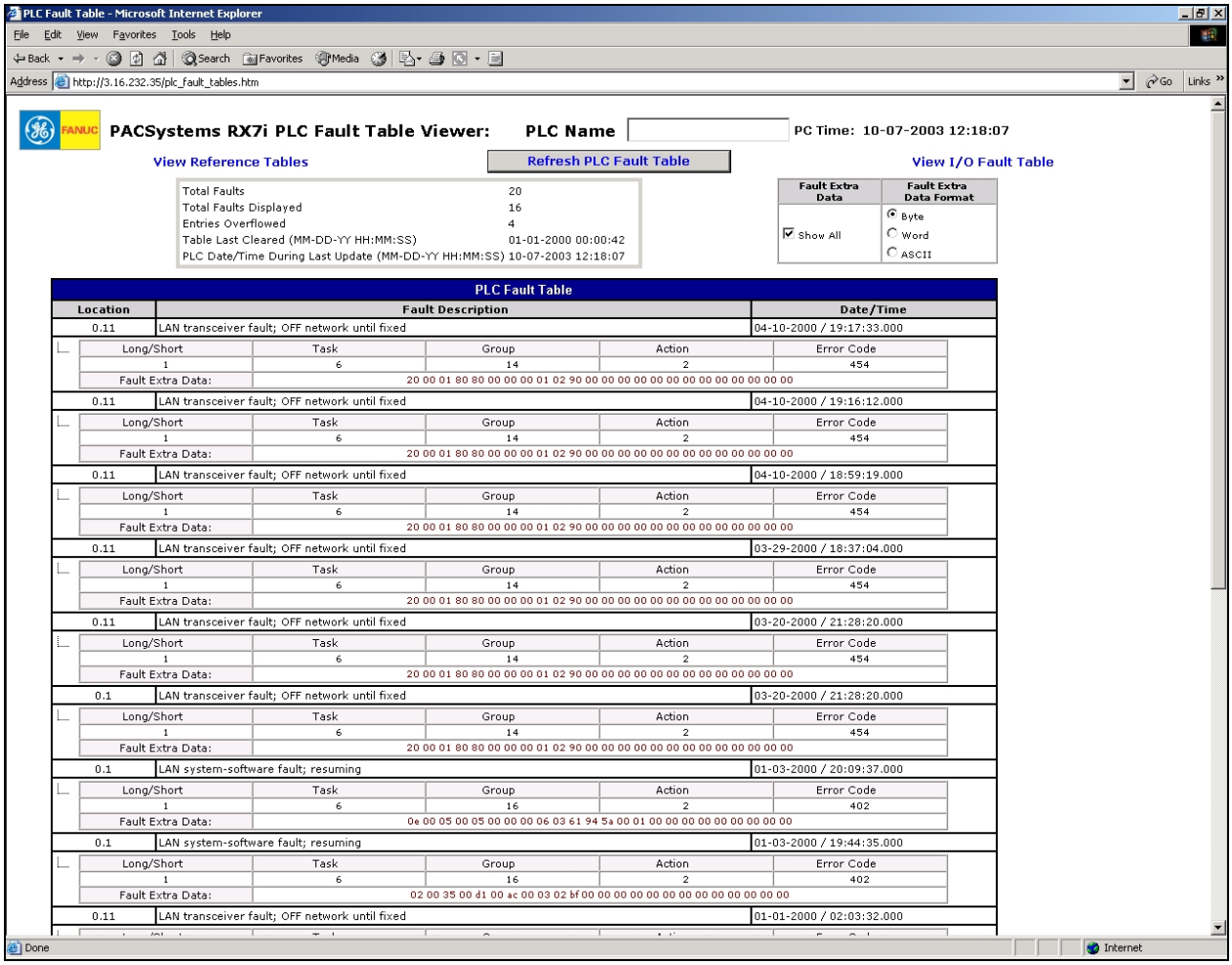
To refresh the fault data, click the 'Refresh PLC Fault Table' button.

When using Internet Explorer, the fault extra data can be viewed by using the mouse to highlight a particular fault and then clicking on the fault. This is shown below:


PLC Fault Table - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Address http://3.16.232.35/plc_fault_tables.htm
PACSystems RX7i PLC Fault Table Viewer:
PLC Name
PC Time: 10-07-2003 12:18:07
View Reference Tables
Refresh PLC Fault Table
View I/O Fault Table
Total Faults 20
Total Faults Displayed 16
Entries Overflowed 4
Table Last Cleared (MM-DD-YY HH:MM:SS) 01-01-2000 00:00:42
PLC Date/Time During Last Update (MM-DD-YY HH:MM:SS) 10-07-2003 12:18:07
Fault Extra Data
Fault Extra Data Format
Show All
Byte
Word
ASCII
PLC Fault Table
Location
Fault Description
Date/Time
0.11 LAN transceiver fault; OFF network until fixed 04-10-2000 / 19:17:33.000
Long/Short
Task
Group
Action
Error Code
1
6
14
2
454
Fault Extra Data:
20 00 01 80 80 00 00 00 01 02 90 00 00 00 00 00 00 00 00 00 00 00 00 00
0.11 LAN transceiver fault; OFF network until fixed 04-10-2000 / 19:16:12.000
0.11 LAN transceiver fault; OFF network until fixed 04-10-2000 / 18:59:19.000
0.11 LAN transceiver fault; OFF network until fixed 03-29-2000 / 18:37:04.000
0.11 LAN transceiver fault; OFF network until fixed 03-20-2000 / 21:28:20.000
0.1 LAN transceiver fault; OFF network until fixed 03-20-2000 / 21:28:20.000
0.1 LAN system-software fault; resuming 01-03-2000 / 20:09:37.000
0.1 LAN system-software fault; resuming 01-03-2000 / 19:44:35.000
0.11 LAN transceiver fault; OFF network until fixed 01-01-2000 / 02:03:32.000
0.1 No user program present 01-01-2000 / 02:03:32.000
0.11 LAN transceiver fault; OFF network until fixed 01-01-2000 / 02:03:09.000
0.1 No user program present 01-01-2000 / 02:03:09.000
0.11 LAN transceiver fault; OFF network until fixed 01-01-2000 / 02:02:44.000
0.1 No user program present 01-01-2000 / 02:02:44.000
0.11 LAN transceiver fault; OFF network until fixed 01-01-2000 / 00:06:46.000
0.1 No user program present 01-01-2000 / 00:06:46.000
Done
Internet

The fault extra data can be displayed in byte, word or ASCII format depending on which button is selected at the top of the screen. These selections affect the display of all fault extra data. If an error code does not have a string associated with it, the “Fault Description” field is blank.

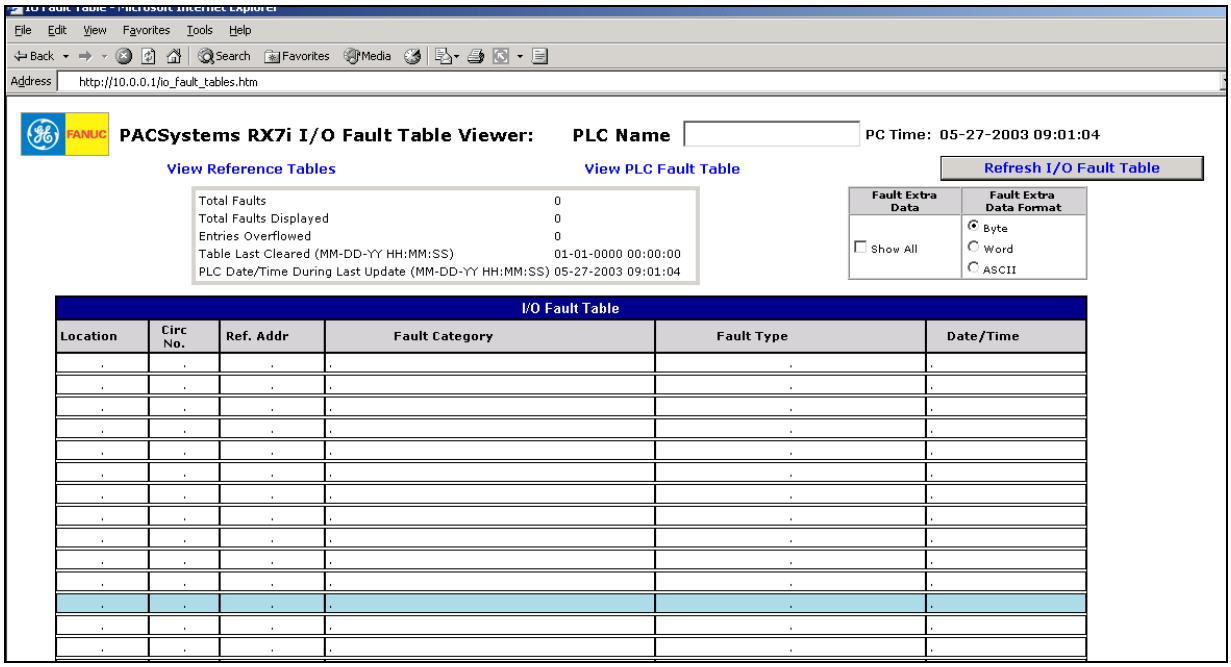
To view the fault extra data for all faults, select the “Show All” checkbox as shown below:


PLC Fault Table - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Address http://3.16.232.35/plc_fault_tables.htm
PACSystems RX7i PLC Fault Table Viewer:
PLC Name
PC Time: 10-07-2003 12:18:07
View Reference Tables
Refresh PLC Fault Table
View I/O Fault Table
Total Faults 20
Total Faults Displayed 16
Entries Overflowed 4
Table Last Cleared (MM-DD-YY HH:MM:SS) 01-01-2000 00:00:42
PLC Date/Time During Last Update (MM-DD-YY HH:MM:SS) 10-07-2003 12:18:07
Fault Extra Data
Show All
Fault Extra Data Format
Byte
Word
ASCII
PLC Fault Table
Location
Fault Description
Date/Time
0.11 LAN transceiver fault; OFF network until fixed 04-10-2000 / 19:17:33.000
Long/Short Task Group Action Error Code
1 6 14 2 454
Fault Extra Data: 20 00 01 80 80 00 00 00 01 02 90 00 00 00 00 00 00 00 00 00 00 00 00 00
0.11 LAN transceiver fault; OFF network until fixed 04-10-2000 / 19:16:12.000
Long/Short Task Group Action Error Code
1 6 14 2 454
Fault Extra Data: 20 00 01 80 80 00 00 00 01 02 90 00 00 00 00 00 00 00 00 00 00 00 00 00
0.11 LAN transceiver fault; OFF network until fixed 04-10-2000 / 18:59:19.000
Long/Short Task Group Action Error Code
1 6 14 2 454
Fault Extra Data: 20 00 01 80 80 00 00 00 01 02 90 00 00 00 00 00 00 00 00 00 00 00 00 00
0.11 LAN transceiver fault; OFF network until fixed 03-29-2000 / 18:37:04.000
Long/Short Task Group Action Error Code
1 6 14 2 454
Fault Extra Data: 20 00 01 80 80 00 00 00 01 02 90 00 00 00 00 00 00 00 00 00 00 00 00 00
0.11 LAN transceiver fault; OFF network until fixed 03-20-2000 / 21:28:20.000
Long/Short Task Group Action Error Code
1 6 14 2 454
Fault Extra Data: 20 00 01 80 80 00 00 00 01 02 90 00 00 00 00 00 00 00 00 00 00 00 00 00
0.1 LAN transceiver fault; OFF network until fixed 03-20-2000 / 21:28:20.000
Long/Short Task Group Action Error Code
1 6 14 2 454
Fault Extra Data: 20 00 01 80 80 00 00 00 01 02 90 00 00 00 00 00 00 00 00 00 00 00 00 00
0.1 LAN system-software fault; resuming 01-03-2000 / 20:09:37.000
Long/Short Task Group Action Error Code
1 6 16 2 402
Fault Extra Data: 0e 00 05 00 05 00 00 00 06 03 61 94 5a 00 01 00 00 00 00 00 00 00 00 00
0.1 LAN system-software fault; resuming 01-03-2000 / 19:44:35.000
Long/Short Task Group Action Error Code
1 6 16 2 402
Fault Extra Data: 02 00 35 00 d1 00 ac 00 03 02 bf 00 00 00 00 00 00 00 00 00 00 00 00 00
0.11 LAN transceiver fault; OFF network until fixed 01-01-2000 / 02:03:32.000
Done
Internet

For Netscape, first check the “Show All” checkbox and press the “Refresh PLC Fault Table” button. This will show the fault extra data for all faults. Netscape cannot show fault extra data for selected faults. To hide the fault extra data, uncheck the “Show All” checkbox and again press the “Refresh PLC Fault Table” button.

I/O Fault Table Viewer Page

The IO Fault Table web viewer page displays the contents of the I/O Fault Table:



The fault extra data can be shown or hidden by clicking on a fault. The fault extra data for all faults in the table can be displayed by selecting the checkbox at the top of the page labeled ‘Fault Extra Data’. To change the format of the fault extra data, select the appropriate checkbox at the top of the page.

To refresh the fault data, click the ‘Refresh I/O Fault Table’ button.

Downloading PLC Web Pages

To add new or revised web page files or support files, you will need to transfer the appropriate files to the Ethernet Interface via FTP. Once the new web files have been obtained, they are copied into the local computer from which the FTP utility will be run. A general procedure for transferring web files via Windows FTP is described below. (You may also use a commercial FTP program.)

FTP Connect and Login

You can either use a commercial FTP tool or use the “ftp” command on the DOS Prompt or Command line (Note: Not all FTP tools will be guaranteed to work since the server only supports a limited set of FTP commands).

From the Windows DOS box command line interface, enter “ftp” followed by the URL or IP address of the PLC as shown below:

```
ftp <URL or IP address of the Ethernet Interface>
```

You will then be prompted for a login name and password as shown below. The default FTP password is “system”.

```
login: user
password: system
```

The FTP server in the PLC Ethernet interface does not support multiple levels of login (there are no distinct ‘anon’ or ‘user’ logins). Once successfully logged on, your can execute any of the FTP commands described below; this login is required in order to store web page files to the Ethernet Interface.

Changing the Password

The default FTP password is “system”. You can change the FTP password via a parameter in the AUP file, which is stored to the PLC via the programmer, or by using the Station Manager.

Changing the Password from the Advanced User Parameters File

The following line should be added to the AUP file to change the FTP password (for example, to “my_ftp_pw”):

```
tpassword = my_ftp_pw
```

Changing the Password from the Station Manager

In addition, you can change the FTP password (for example to “my_ftp_pw”) using the following Station Manager command:

```
= CHPARM  tpassword  my_ftp_pw
```

The FTP password can be up to 10 characters long and uses the same character set listed for the reference viewer password described later in this document. These passwords are not case sensitive.

Arguments for Station Manager CHPARM command must be enclosed in double quotes to preserve the capitalization of the argument. However since these passwords are case insensitive, the double quotes are not required.

Note: The CHPARM command is not available if the PLC has received a valid configuration from the Programmer.

Web Page File Transfer

After logging into the PLC's FTP server, web page files can be copied from the PC to the PLC through the following steps:

1. Set the FTP file transfer type to binary by typing in "binary"
2. For each file, change to the desired directory if appropriate by typing "cd ./subdirectory". Then transfer the file using the "put" command by typing: "put filename.htm"
3. Verify all files are properly transferred by typing in: "dir" or "ls". This returns a list of the files located at the current directory on the PLC Ethernet Interface
4. Quit the FTP session by typing in "quit" or "bye".

If you copy a file that already exists in the module, the new file overwrites the existing file without warning. One of the files stored will be a fault string file that will be specific for each language supported.

The PLC FTP server also supports the following standard FTP commands:

- "get" command - allows the user to transfer files from the PLC web server to their local PC (for example "get filename1.htm").
- "delete" command – allows user to delete web pages from the server (for example "delete filename1.htm").

Viewing the RX7i PLC Web Pages

Each web browser (HTTP) instance (i.e., each browse window) requires at least two TCP connection and each FTP session requires two TCP connections to the PLC. The maximum number of web browser connections and FTP connections at the Ethernet interface at any one time are separately configurable from 0 to 16 (a value of 0 means that the web server or FTP capability is disabled). The total number of configured web browser connections plus FTP connections is limited to 16 connections; once the number of browser/FTP connections reaches the configurable limit, any new browser or FTP connection requests will fail.

The number of Web Server and FTP connections is configurable via the Programmer. The Programmer configuration details are described in the Programmer Help utility.

When the PLC is unconfigured, the user can change the number of web server (HTTP) connections and FTP connections with the following Station Manager commands, respectively:

```
CHSOSW  web_max_conn  <number from 0-16>

CHSOSW  ftp_max_conn  <number from 0-16>
```

As noted in the Ethernet Configuration section, the sum of web server connections plus FTP connections must not exceed 16 connections.

For example:

```
= CHSOSW  web_max_conn 6

= CHSOSW  ftp_max_conn 4
```

Note: The CHSOSW commands are not available if the PLC has received a valid configuration from the Programmer.

Chapter 8 Diagnostics

This chapter describes diagnostic techniques for a PACSystems Ethernet Interface.

- Diagnostic Tools Available for Troubleshooting
- States of the Ethernet Interface
- EOK Blink Codes for Hardware Failures
- PLC Fault Table
- Monitoring the Ethernet Interface Status Bits
- Monitoring the FT Output of the COMMREQ Function Block
- Monitoring the COMMREQ Status Word
- Troubleshooting Common Ethernet Difficulties

What to do if you Cannot Solve the Problem

If you cannot solve the problem, contact GE Fanuc Automation. Please have the following information ready:

- The Name and Catalog Number marked on the product.
  - PLC CPU version number from CME Status screen
  - Ethernet Interface CPU Embedded or standalone
- Description of symptoms of problem. Depending on the problem, you may also be asked for the following information:
  - The ladder logic application program and the PLC sweep time at the time the problem occurred.
  - A listing of the configuration parameters for the Ethernet Interface that failed.
  - A description of the network configuration. This should include the number of PLCs and host computers accessing the network, the type of network cable used (e.g. twisted pair, fiber optic, etc.), length of network cable, and the number and manufacturer of transceivers, hubs, and network switches used.
  - Description on ALL Ethernet communication activity for the PLC.
  - Versions of all software doing Ethernet communication to the PLC. This includes CIMPLICITY PE, ME, IFIX, etc.
  - Be prepared to provide the PLC Fault Table showing Fault Extra Data
  - Be prepared to provide Station Manager Log showing Ethernet Events

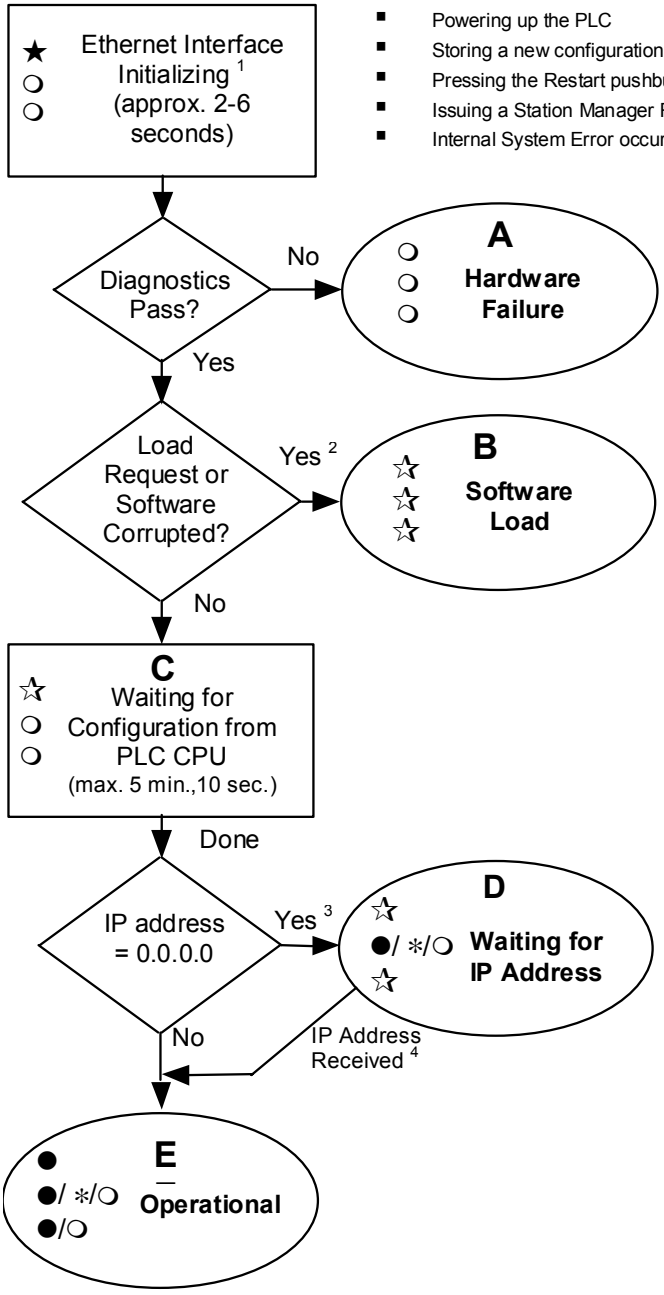
Diagnostic Tools Available for Troubleshooting

There are several tools to assist you in diagnosing problems with the Ethernet Interface and the network.

- Use the ***Ethernet Interface LEDs*** to troubleshoot a problem on power-up of the Ethernet Interface and for an immediate visual summary of the operational state of the Interface.
- Use the PLC Fault Table to troubleshoot a problem once the Interface is running. It provides a record of exceptions logged by the PLC, the Ethernet Interface, and other I/O and communications modules. The PLC Fault Table is accessed through the PLC programming software or a web browser (for a CPU with embedded Ethernet Interface).
- For PLC Fault Table entries generated by the Ethernet Interface, the Detailed Fault Data for that entry contains the same data as the corresponding event in the Ethernet Interface's exception log. Refer to GFK-2225, TCP/IP Ethernet Communications for the PACSystems Station Manager Manual, for information on how to interpret Ethernet exception log events.
- Use the Ethernet Status Data to troubleshoot the Ethernet Interface status
- For Ethernet Global Data operation, Exchange Status words can be used to troubleshoot exchange operations.
- Use the Station Manager to troubleshoot a problem with the Ethernet Interface, the network, PLC backplane communication, or with your application. The LOG, TALLY, EXS, XCHANGE and STAT Station Manager commands are especially useful.
  - The LOG command provides a complete record of exceptions occurring with the network and Interface.
  - The TALLY command provides statistics about operation and performance of the network and Interface.
  - The EXS command provides information about COMMREQs.
  - The XCHANGE command displays detailed information about a specified Ethernet Global Data exchange. The STAT G command provides the current status on the operation of EGD communications on the Interface.

  Refer to GFK-2225, *PACSystems TCP/IP Ethernet Communications Station Manager Manual*, for information on how to access and use the Station Manager software.

States of the Ethernet Interface



1 **The Ethernet Interface is initialized by**

- Powering up the PLC
- Storing a new configuration to the PLC with changes for the Ethernet Interface
- Pressing the Restart pushbutton
- Issuing a Station Manager RESTART command
- Internal System Error occurring when Interface is operational

2 **Software Load caused by**

- Pressing the Restart pushbutton
- Detection of corrupt software

3 **Waiting for IP Address caused by**

- Not configuring Interface using configuration software
- Configuring Interface with IP Address = 0.0.0.0
- New CPU with no configuration
- CPU failure to communication with Interface

4 **Continue to Operational State caused by**

- IP Address received over network

Operational

- Full support for client and server capability
- Uses user-defined Advanced Parameters

Symbols

The LEDs are labeled from top to bottom as follows:
EOK
LAN
STAT

❍	The symbols used for the LEDs in the chart are: OFF
●	ON
☆	Slow Blink; multiple slow blinking LEDS blink in unison
★	Fast Blink
⁎	Traffic (blinks when there is traffic on the line.
	The process symbols use in this chart are:
	Temporary condition; requires no intervention
	Decision point during powerup
	Interface State; normally the Interface remains in a state unless there is user intervention.

LED Pattern		Where Stopped	Possible Cause	Corrective Actions
❍ ❍ ❍	EOK (OFF) LAN (OFF) STAT (OFF)	A Hardware Failure	Fatal Hardware Error.	Make sure the PLC has power. Examine PLC Fault Table for clues. Recheck PLC Programmer configuration. Power off baseplate, inspect the Interface for loose components, reseat the module, and Restart. If the problem persists, replace the PLC hardware.
✱ ✱ ✱	EOK (Slow blink) LAN (Slow blink) STAT (Slow blink) All LEDs blink in unison.	B Software Loader	Software corrupt.	Connect a PC Software Loader and load new software.
✱ ○ ○	EOK (Slow blink) LAN (OFF) STAT (OFF)	C Waiting for Configuration from PLC	Did not configure slot using the PLC Programmer. CPU not communicating with Ethernet Interface. (Condition can last a maximum of 5 minutes.)	Use the PLC Programmer configuration software to configure the Interface then store the configuration to the PLC CPU. Power cycle the PLC. Clear faults and Restart Interface.
✱ ○ ○	EOK Blinking error code LAN Off STAT Off		Unrecoverable hardware or runtime failure	See the list of blink codes on the next page.
✱ ●✱○ ✱	EOK (Slow blink) LAN (ON/Traffic/OFF) STAT (Slow blink) EOK and STAT blink in unison.	D Waiting for IP Address	Interface's IP address has not been configured or has been configured as 0.0.0.0.	Use the PLC Programmer to configure the Interface with a non-zero IP address. Assign IP address over network
● ●✱○ ●○	EOK (ON) LAN (ON/Traffic/OFF) STAT (ON/OFF)	E Operational	If the LAN LED is OFF, the problem may be network cable not connected If the STAT LED is OFF, an exception condition has occurred.	Connect cable. Examine PLC Fault Table to find out why the STAT LED is OFF.

In the RX7i, the Ethernet LEDs are labeled ***EOK***, ***LAN***, and ***STAT***.
In the RX3i, the Ethernet LEDs are labeled ***ETHERNET OK***, ***LAN OK***, and ***LOG EMPTY***, respectively.

EOK LED Blink Codes for Hardware Failures

The EOK LED indicates whether the module is able to perform normal operation. This LED is on for normal operation and flashing for all other operations. If a hardware or unrecoverable runtime failure occurs, the EOK LED blinks a two-digit error code. The EOK LED first blinks to indicate the most significant error digit, then after a brief pause blinks again to indicate the least significant error digit. After a long pause the error code display repeats

Blink Code	***Description***	***Blink Code***	***Description***
0x12	Undefined or Unexpected Interrupt.	0x42	Firmware Loader error
0x13	Timer failure during power up diagnostics.	0x51	Unexpected watchdog timer exception
0x14	DMA failure during power up diagnostics.	0x52	Unexpected debug exception
0x21	RAM failure during power up diagnostics.	0x61	Boot: Critical interrupt exception
0x22	Stack error during power up diagnostics.	0x62	Boot: Machine check exception
0x23	Shared Memory Interface error during power up diagnostics.	0x63	Boot: Data store exception
0x24	Firmware CRC (cyclic redundancy check) error during power up or Factory Test*	0x64	Boot: Instruction store exception
0x25	Run time exception	0x65	Boot: External interrupt exception
0x26	No mail communication available during software load	0x66	Boot: Alignment exception
0x27	Serial EEPROM access exception	0x67	Boot: Program exception
0x28	Serial EEPROM reset exception	0x68	Boot: System call exception
0x31	Machine check exception	0x69	Boot: PIT interrupt exception
0x32	Data store exception.	0x71	Boot: FIT interrupt exception
0x33	Instruction store exception	0x72	Boot: WDT interrupt exception
0x34	Alignment exception	0x73	Boot: Data cache TLB miss exception
0x35	Program exception	0x74	Boot: Instruction cache TLB miss exception
0x36	System call exception	0x75	Boot: Debug exception
0x37	Unexpected IRQ exception	0x76	Boot: Flash memory CRC error
0x38	Data cache TLB miss exception	0x77	Boot: Unexpected ACFAIL interrupt
0x39	Instruction cache TLB miss exception	0x78	Boot: Unexpected Restart pushbutton interrupt
0x41	BSP startup error		

*CRC error or software error during normal operation causes Ethernet restart

PLC Fault Table

Most error conditions involving the Ethernet interface generate faults in the PLC Fault table. The table on the next two pages lists Ethernet interface faults and corrective actions.

To access the details of a PLC Fault Table entry, double-click the Fault Table entry and the details are displayed as “fault extra data”. Refer to Online Help in the PLC programming software for more information.

An example of the fault extra data is shown below:

```
1600060003000500000000000000000000000000000000000000
| |    |    |   |
```

For Ethernet Interfaces the leftmost 14 digits of fault extra data (underlined in the example above) show the corresponding log Events (2 digits) and Entries 2, 3, and 4 (in that order, 4 digits each). The example above is reporting an Event 16, Entry 2=6, Entry 3=3, and Entry 4=5.

This information can be used to refer directly to detailed fault descriptions included in the Exception Log Event tables in GFK-2225, *TCP/IP Ethernet Communications for the PACSystems Station Manager Manual.* (In that document, Refer to Appendix B, Exception Log Events.)

PLC Fault Table Descriptions

PLC Fault	User Action
Backplane communications with PLC fault; lost request	Check to make sure that the logic application is not sending COMMREQs faster than the Ethernet Interface can process them. Reduce the rate at which the application is sending COMMREQs to the Ethernet interface. If problem persists, contact GE Fanuc Automation.
Bad local application request; discarded request	Check for valid COMMREQ command code. If problem persists, contact GE Fanuc Automation.
Bad remote application request; discarded request	Try to validate the operation of the remote node. If problem persists, contact GE Fanuc Automation.
Can't locate remote node; discarded request	Error reported when message received where IP/MAC address cannot be resolved. Error may indicate that remote host is not operational on the network. Check that remote host is operational on network and its addresses are correct.
Comm_req - Bad task ID programmed	Message from PLC for unknown Ethernet Interface task. Check COMMREQ function block.
Comm_req - Wait mode not allowed	Check COMMREQ to make sure sent in no-wait mode.
Configured gateway address bad; can't talk off local net	Error in configuration. Verify that IP address, Subnetwork Mask, and default Gateway IP address are correct.
Connection to remote node failed; resuming without it	Underlying communications software detects error transferring data; resuming. If persistent error, check connection to LAN and operation of remote node.
LAN controller fault; restart LAN I/F	HW fault, perform a power cycle. If problem persists, contact GE Fanuc Automation.
LAN controller Tx underflow; attempt recovery	Internal system error. If problem persists, contact GE Fanuc Automation.
LAN controller under run/overrun; resuming	Internal system error. If problem persists, contact GE Fanuc Automation.
LAN data memory exhausted - check parameters; resuming	The Ethernet Interface does not have free memory to process communications. If problem persists, contact GE Fanuc Automation.
LAN duplicate MAC Address; resuming	A frame was received in which the source MAC Address was the same as this station's MAC Address. All stations on a network must have a unique MAC address. Immediately isolate the offending station; it may be necessary to turn it off or disconnect it from the network. This station remains Online unless you intervene to take it Offline.
LAN I/F can't init - check parameters; running soft Sw utl	Internal system error. If problem persists, contact GE Fanuc Automation.
LAN I/F capacity exceeded; discarded request	Verify that connection limits are not being exceeded.
LAN interface hardware failure; switched off network	Replace the Ethernet Interface.

PLC Fault	User Action
LAN network problem exists; performance degraded	Excessive backlog of transmission requests due to excessive traffic on the network. For a sustained period the MAC was unable to send frames as quickly as requested. If problem persists, contact GE Fanuc Automation.
LAN severe network problem; attempting recovery	External condition prevented transmission of frame in specified time. Could be busy network or network problem. Check transceiver to make sure it is securely attached to the network.
LAN system-software fault; aborted connection resuming	Internal system error. If problem persists, contact GE Fanuc Automation.
LAN system-software fault; restarted LAN I/F	Internal system error. If problem persists, contact GE Fanuc Automation.
LAN system-software fault; resuming	Internal system error. If problem persists, contact GE Fanuc Automation.
LAN transceiver fault; OFF network until fixed	Transceiver or transceiver cable failed or became disconnected. Reattach the cable or replace the transceiver cable. Check SQE test switch if present on transceiver.
Local request to send was rejected; discarded request	Internal error. Check that the Ethernet Interface is online. If problem persists, contact GE Fanuc Automation.
Memory backup fault; may lose configuration/log on restart	Internal error accessing non-volatile device. If problem persists, contact GE Fanuc Automation - NA. Replace Ethernet Interface.
Module software corrupted; requesting reload	Catastrophic internal system error. Contact GE Fanuc Automation.
Module state doesn't permit Comm_Req; discarded	COMMREQ received when Ethernet Interface cannot process COMMREQ. Make sure Ethernet Interface is configured and online. Error may occur if the logic application is sending COMMREQs faster than the Ethernet Interface can process them. Reduce the rate at which COMMREQs are sent.
Unsupported feature in configuration	PLC firmware does not support Ethernet communications software or attempt has been made to configure a feature not supported by the Ethernet Interface. Check CPU and Ethernet Interface revisions, order upgrade kit for CPU and/or Ethernet Interface.
Can't locate remote node; discarded request	A specified remote device does not exist on the network. Check that the remote device IP address is correct and that the remote device is functioning properly.
Mailbox Queue full – Comm_req aborted	The CPU is attempting to send COMMREQs faster than the Ethernet Interface can receive them. The PLC logic program should retry the COMMREQ after a short delay. If the condition persists, the logic application should be revised to reduce the rate at which it sends COMMREQs to the Ethernet Interface.
Non-critical CPU software event	The CPU is attempting to send mail messages faster than they can be retrieved by the Ethernet Interface; the messages are discarded. This can result in subsequent "Backplane communications with PLC fault; lost request" faults.

Monitoring the Ethernet Interface Status Bits

The Ethernet Interface status bits normally occupy a single block of memory. The memory location is specified during configuration of the Ethernet Interface. The status bits are updated in the CPU once each PLC scan by the Ethernet Interface. These bits are generally used to prevent initiation of a COMMREQ function when certain errors occur.

The first 16 bits of the block are the LAN Interface Status (LIS) bits. The next 64 bits are reserved. Unless the "LAN Interface OK" bit is set (Status Bit 16), the other status bits are invalid.

Status Bits	***Brief Description***
1	Port 1A full duplex
2	Port 1A 100Mbps
3	Port 1B full duplex
4	Port 1B 100 Mbps
5	Reserved
6	Redundant IP address is active (RX7i only)
7-8	Reserved
9	Any SRTP Channel Error (error on any channel)
10–12	Reserved
13	LAN OK
14	Resource problem
15	Module Overtemperature (RX3i only)
16	LAN Interface OK
17 - 80	Reserved

LAN Interface Status (LIS) Bits

The LAN Interface Status bits monitor the health of the Ethernet Interface itself.

Bit 1, Port 1a Full Duplex: This bit is set to 1 when Port 1A is set to full duplex. Full-duplex or half-duplex operation is automatically negotiated between the Ethernet Interface and its immediately-connected network device, usually a network hub or switch. If this bit is 0, the port is in half-duplex Ethernet mode. This bit is only valid if bit 13 (LAN OK) is 1.

Bit 2, Port 1A 100Mbps: This bit is set to 1 when Port 1A is operating at 100Mbps.

Bit 3, Port 1B Full Duplex: This bit is set to 1 when Port 1B is set to full duplex. Full-duplex or half-duplex operation is automatically negotiated between the Ethernet Interface and its immediately-connected network device, usually a network hub or switch. If this bit is 0, the port is operating in half-duplex Ethernet mode. This bit is only valid if bit 13 (LAN OK) is 1.

Bit 4, Port 1B 100Mbps: This bit is set to 1 when Port 1B is operating at 100Mbps.

Bit 6, Redundant IP Address Active: This bit is set to 1 when the configured Redundant IP address is active. (The Ethernet Redundancy feature is available in the RX7i only.) Otherwise this status bit is set to 0.

Bit 9, Reserved

Bit 13, LAN OK: This bit is 1 as long as the Ethernet Interface software is able to communicate on the network. If the network becomes inaccessible due to local or network problems, this bit is set to 0. If LAN communication becomes possible again, it is set to 1.

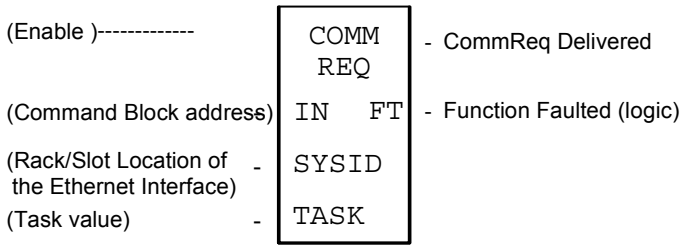
Bit 14, Resource Problem: This bit is set to 1 if the Ethernet Interface software has a resource problem (i.e., lack of data memory). The bit is reset to 0 on a subsequent PLC sweep. The Ethernet Interface may or may not be able to continue functioning, depending on the severity of the problem. Look in the PLC Fault Table for details. In addition, the Station Manager STAT B and LOG commands can be used. See the *Station Manager Manual*, GFK-2225, for more information.

Bit 15, Module Overtemperature: This bit is set if the Ethernet interface hardware has detected that the internal temperature has exceeded normal limits. The bit is cleared when the internal temperature has not exceeded normal limits, or has recovered from an over-temperature condition. (Overtemperature indication is available in the RX3i only.)

Bit 16, LAN Interface OK Bit: This bit is set to 1 by the Ethernet Interface each PLC scan. If the Ethernet Interface cannot access the PLC, the CPU sets this bit to 0. *When this bit is 0, all other Ethernet Interface Status bits are invalid.*

Monitoring the FT Output of the COMMREQ Function Block.

The COMMREQ function block indicates its status through its FT output:



If after executing a COMMREQ Function, the FT Output is ON, there is a programming error in one or more of the following areas.

- Invalid rack/slot specified. The module at this rack/slot is unable to receive a COMMREQ Command Block.
- Invalid Task ID. This value should always be 65536 decimal (10000H) for the CPU Ethernet daughterboard, or 0 decimal (0000H) for the Ethernet module.
- Invalid Data Block length (0 or greater than 128).

This output also may indicate that no more COMMREQ functions can be initiated in the ladder program until the Ethernet Interface has time to process some of the pending COMMREQ functions.

If the FT Output is set, the CPU did not transfer the Command Block to the Ethernet Interface. In this case, the other status indicators are not updated for this COMMREQ. The Ethernet Interface is unable to return a COMMREQ Status Word to the PLC logic application.

Monitoring the COMMREQ Status Word

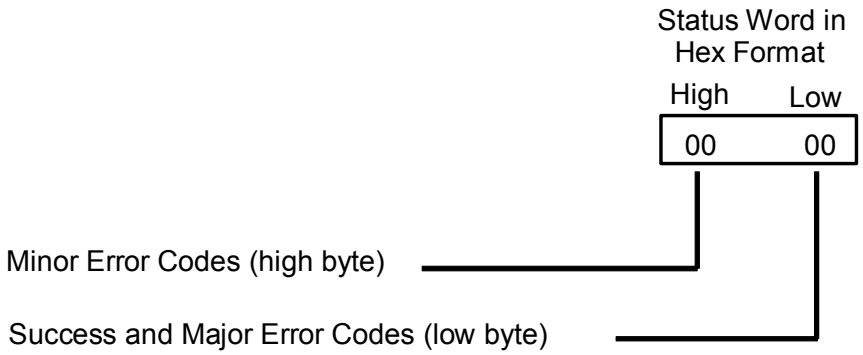
Every COMMREQ Command Block instruction specifies a 1-word memory address to receive status information about the execution of the command.

Before executing a COMMREQ for the Ethernet interface, the application program logic should the associated status word zero (for example, using a MOVE Word instruction). After executing a COMMREQ, the program should monitor its status word. If the status word is updated to a one (1), the command has been processed successfully. If the status word is updated to a value other than 1, an error has occurred. Any data returned by that command should not be used until the problem is corrected and the status word indicates success. It is critical to monitor the COMMREQ status word for each COMMREQ function. .

If after executing a COMMREQ function, the COMMREQ status word is zero (0), the success Output is ON and the FT Output is OFF, the Command Block has been sent to the Ethernet Interface, but no status has been returned. If this condition persists, check the PLC Fault Table for information.

Format of the COMMREQ Status Word

Displaying the status word in hexadecimal form makes it easier to differentiate the high and low bytes. This can be done using a MOVE WORD function block to display the hexadecimal value within the ladder program.



The following tables list the error codes that are reported in the COMMREQ Status word after the execution of a COMMREQ function.

Major Error Codes in the COMMREQ Status Word

Success or a Major Error Code appears in the low byte of the COMMREQ Status Word. Hexadecimal values for the low byte are listed below. For many Major Error Codes, additional information appears as a Minor Error Code in the high byte of the COMMREQ Status Word. Hexadecimal values for the high byte are listed on the following pages.

Error Status (Hexadecimal)	Major Error Description
01H	Successful Completion. (This is the expected completion value in the COMMREQ Status word.)
02H	Insufficient Privilege at server PLC. For a PACSystems or Series 90-70 server PLC, the minor error code contains the privilege level required for the service request.
04H	Protocol Sequence Error. The server CPU has received a message that is out of order. *Call GE Fanuc Automation for assistance.*
05H	Service Request Error at server PLC. The minor error code contains the specific error code. See the following table of Minor Error codes.
06H	Illegal Mailbox Type at server PLC. Service request mailbox type is either undefined or unexpected. *Call GE Fanuc Automation for assistance.*
07H	The server PLC CPU's Service Request Queue is full, usually due to heavy CPU loading. The client should retry later. It is recommended that the client wait a minimum of 10 milliseconds before sending another service request.
0BH	Illegal Service Request. The requested service is either not defined or not supported at the server PLC. (This value is returned in lieu of the actual service request error (01H), to avoid confusion with the normal successful COMMREQ completion.) *Call GE Fanuc Automation for assistance.*
11H	SRTP Error Code at server. An error was detected at the SRTP server. See the following table of Minor Error codes.
82H	Insufficient Privilege at client PLC. The minor error code contains the privilege level required for the service request.
84H	Protocol Sequence Error. The CPU has received a message that is out of order. *Call GE Fanuc Automation for assistance.*
85H	Service Request Error at the client PLC. The minor error code contains the specific error code. See the following table of Minor Error codes.
86H	Illegal Mailbox Type. Service request mailbox type is either undefined or unexpected. *Call GE Fanuc Automation for assistance.*
87H	The client PLC CPU's Service Request Queue is full. The client should retry later. It is recommended that the client wait a minimum of 10 milliseconds before sending another service request.
8BH	Illegal Service Request. The requested service is either not defined or not supported. (This value is returned in lieu of the actual service request error (01H), to avoid confusion with the normal successful COMMREQ completion.). *Call GE Fanuc Automation for assistance.*
90H	SRTP Client API error. See the following table of Minor Error codes. (Some EGD command errors also use major code 90 when indicating the same error condition as the SRTP client.)
A0H	EGD Command error. See the following table of Minor Error codes.

Minor Error Codes for Major Error Codes 05H (at Remote Server PLC) and 85H (at Client PLC)

Error Status (Hexadecimal)		Error Description
Remote Server	**Client**	
8F05H	8F85H	Session already exists.
8E05H	8E85H	Memory write is prohibited.
9005H	9085H	Invalid PLC memory reference range.
9305H	9385H	Text buffer length/count does not agree with request parameters.
C105H	C185H	Invalid block state transition.
C305H	C385H	Text length does not match traffic type.
C605H	C685H	Control Program (CP) tasks exist but requestor not logged into main CP.
C705H	C785H	Passwords are set to inactive and cannot be enabled or disabled.
C805H	C885H	Password(s) already enabled and cannot be forced inactive.
C905H	C985H	Login using non-zero buffer size required for block commands.
CA05H	CA85H	Device is write-protected.
CB05H	CB85H	A comm or write verify error occurred during save or restore.
CC05H	CC85H	Data stored on device has been corrupted and is no longer reliable.
CD05H	CD85H	Attempt was made to read a device but no data has been stored on it.
CE05H	CE85H	Specified device has insufficient memory to handle request.
CF05H	CF85H	Specified device is not available in the system (not present).
D105H	D185H	Packet size or total program size does not match input.
D205H	D285H	Invalid write mode parameter.
D505H	D585H	Invalid block name specified.
D605H	D685H	Total datagram connection memory exceeded.
D705H	D785H	Invalid datagram type specified.
D805H	D885H	Point length not allowed.
D905H	D985H	Transfer type invalid for this Memory Type selector.
DA05H	DA85H	Null pointer to data in Memory Type selector.
DB05H	DB85H	Invalid Memory Type selector in datagram.
DC05H	DC85H	Unable to find connection address.
DD05H	DD85H	Unable to locate given datagram connection ID.
DE05H	DE85H	Size of datagram connection invalid.
DF05H	DF85H	Invalid datagram connection address.

continued

Minor Error Codes for Major Error Codes 05H (at Remote Server PLC) and 85H (at Client PLC)

Continued from previous page

Error Status (Hexadecimal)		Error Description
Remote Server	**Client**	
E005H	E085H	Service in process cannot login.
E405H	E485H	Memory Type for this selector does not exist.
E905H	E985H	Memory Type selector not valid in context.
EA05H	EA85H	Not logged in to process service request.
EE05H	EE85H	Could not return block sizes.
EF05H	EF85H	Programmer is already attached.
F005H	F085H	Request only valid in stop mode.
F105H	F185H	Request only valid from programmer.
F205H	F285H	Invalid program cannot log in.
F405H	F485H	Invalid input parameter in request.
F505H	F585H	Invalid password.
F605H	F685H	Invalid sweep state to set.
F705H	F785H	Required to log in to a task for service.
F805H	F885H	Invalid program name referenced.
F905H	F985H	Task address out of range.
FC05H	FC85H	I/O configuration is invalid.
FE05H	FE85H	No privilege for attempted operation.
FF05H	FF85H	Service request has been aborted.

Minor Error Codes for Major Error Code 11H (at Remote Server PLC)

Error Status (Hexadecimal)	SRTP Error Description
0111H	Generic SRTP error.
0211H	The PLC is inaccessible.
0311H	Reserved.
0411H	Unexpected SRTP version encountered in received message.
0511H	Unrecognized SRTP message received.
0611H	Data present in SRTP message which should not contain data.
0711H	Generic resource problem detected.
0811H	SRTP message encountered in inappropriate connection state.
0911H	Generic refusal by backplane driver to handle request.
0A11H	Recognized but unsupported SRTP message received.
0B11H	Lost transaction in server.
0C11H	Error sending SRTP PDU to the client PLC.
1411H	Unable to allocate a text buffer from dual port memory.
1711H	Invalid text length detected in a mailbox message.
1811H	Invalid number of destinations detected in a mailbox message.
1911H	Invalid source detected in a mailbox message.
1A11H	Invalid slot number detected in a mailbox message.
1B11H	Invalid rack number detected in a mailbox message.
1D11H	Bad text buffer address in dual port memory.
2111H	Unable to find control data required to send a mailbox message to the PLC.
2211H	Timed out waiting for availability of mail communications with the PLC.
2311H	Invalid task ID detected while attempting to send a mailbox message to the PLC.
2411H	Unable to send mailbox message to PLC because the mail queue is full.
2611H	Unable to communicate with PLC.
2711H	Backplane driver not initialized or unable to acquire a dual port memory semaphore.
2A11H	The backplane driver could not access the PLC.
2B11H	Invalid binding on the message sent to the backplane driver.
2C11H	The message could not be sent to its destination because the mailbox was not open.
2D11H	The maximum number of transfers to the destination is already taking place.
2E11H	The maximum number of transfers of this transfer type is already taking place.
2F11H	Cannot obtain a backplane transfer buffer.

continued

Minor Error Codes for Major Error Code 11H (at Remote Server PLC)

Continued from previous page

Error Status (Hexadecimal)	SRTP Error Description
3011H	Cannot obtain resources other than backplane transfer buffers.
3111H	Connection ID or block transfer ID is not valid.
3211H	Timed out waiting for PLC CPU response.
3311H	The PLC CPU aborted the request.
3411H	An invalid message type was specified.
3511H	The specified task is not registered.
3611H	The mailbox offset specified is invalid.
3711H	The backplane task could not be registered because the message response handler was not specified.
3811H	The backplane task could not be registered because the unsolicited mailbox message handler was not specified.
3911H	The backplane task could not be registered because a required parameter was not specified.
3A11H	More than the allowable byte length in a single transfer.
3B11H	Bad sequence number in the request.
3C11H	Invalid command in request.
3D11H	Response length does not match length specified in the response qualifier.
3E11H	Request failed because the PLC's Service Request Processor is not initialized.
3F11H	Request failed due to an error in the remote device, most likely running out of Dual-Port RAM text buffers.
4011H	Unable to free dual port memory that was allocated for a connection or block transfer area.
4111H	The backplane task could not be registered because the service request handler was not specified.
4211H	No dual port memory was allocated for the connection or block transfer area needed to process the request.
4311H	Failure to register with backplane driver because the requested task is already registered.
4411H	Request failed because an invalid field was identified in the request mailbox qualifier.

continued

Minor Error Codes for Major Error Code 11H (at Remote Server PLC)

Continued from previous page

Error Status (Hexadecimal)	SRTP Error Description
E811H	Unable to send request to the PLC because an internal message queue is full.
E911H	Unable to send request to the PLC because the text buffer type is invalid.
EA11H	Unable to send request to the PLC because the mailbox utility function is invalid.
EB11H	Unable to send request to the PLC because the mailbox message is not specified.
EC11H	Unable to send request to the PLC because the internal message queue is not initialized.
FE11H	Request failed due to mailbox error on remote device. The remote device log will have more information.
2911H	The backplane driver is not initialized.
2A11H	The backplane driver could not access the PLC.
2F11H	Request failed due to an invalid parameter detected in the remote device. The remote device log will have more information.
3011H	The specified task is not registered.
3111H	Failure to register with backplane driver because the requested task is already registered.
3211H	Unable to find resource necessary for backplane driver to process a service request.
3311H	Bad sequence number detected in the service request because it is already in use.
3411H	Invalid data detected that prevents backplane driver from completing a request.
3611H	More than the allowable byte length in a single transfer.
4811H	Memory resource problem detected.
4911H	Network buffer resource problem detected.
4C11H	Error detected while attempting to receive mailbox messages from the PLC.
4D11H	Timed out waiting to obtain a backplane transfer buffer.
4E11H	Timed out waiting to transfer a mailbox message to the PLC.
4F11H	Timed out waiting for PLC CPU response.

Minor Error Codes for Major Error Code 90H (at Client PLC)

Error Status (Hexadecimal)	Error Description
0190H	Timeout expired before transfer completed; still waiting on transfer.
0290H	Period expired before transfer completed; still waiting on transfer.
8190H	COMMREQ data block too short for the command.
8290H	COMMREQ data block too short for server PLC node address.
8390H	Invalid server memory type.
8490H	Invalid Program Name.
8590H	Invalid Program Block Name.
8690H	Zero server unit length is not allowed.
8790H	Server unit length is too large.
8890H	Invalid channel number.
8990H	Invalid time unit for period. (Maximum permitted 3965 hours)
8A90H	Period value is too large.
8B90H	Zero server memory starting address is not allowed.
8C90H	Invalid client memory type.
8D90H	Invalid server host address type.
8E90H	Invalid IP address integer value. (Must be 0–255)
8F90H	Invalid IP address class. (Must be valid Class A, B, or C IP address)
9090H	Insufficient TCP connection resources to do request.
9190H	Zero local starting address is not allowed.
9290H	Address length value invalid. Must be 4 for address type 1.
9390H	COMMREQ data block too short for Program Block name (including 0 pad).
9490H	COMMREQ data block too short for Program name (including 0 pad).
9590H	Internal API error. See PLC Fault Table or exception log for details. This problem may occur due to the Ethernet Interface being asked to perform beyond its capacity. Try transferring less data per message or establishing fewer simultaneous connections.
9690H	Underlying TCP connection aborted (reset) by server end point.
9790H	Underlying TCP connection aborted by client end point.
9890H	The remote server has no Service Request Processor.
9A90H	Response to session request did not arrive in proper order.
9B90H	Session denied by server PLC.
9C90H	Data response did not arrive in proper order.
9D90H	Data response had unexpected size.
9E90H	Unrecognized COMMREQ command code.

continued

Minor Error Codes for Major Error Code 90H (at Client PLC)

Continued from previous page

Error Status (Hexadecimal)	Error Description
A190H	Invalid CRS word memory type.
A290H	Failed an attempt to update the CRS word.
A390H	*Reserved.*
A490H	*Reserved.*
A590H	*Reserved.*
A690H	Invalid bit mask.
A790H	Unable to connect to remote device.
B090H	Network Address name length error. The name cannot exceed 31 ASCII characters and must be terminated with a NUL character (zero).
B190H	Specified Network Address name could not be resolved into an IP address.
B390H	Internal name resolution error. See PLC Fault Table or exception log for details.
B590H	The channel the application is trying to access is owned by a different protocol.
C090H	(Redundancy only) COMMREQs commands are not allowed when Redundant IP address is not active at this Ethernet interface.

Minor Error Codes for Major Error Code A0H (at Client PLC)

Error Status (Hexadecimal)	Error Description
01A0H	Remote exchange is not healthy.
02A0H	Remote exchange is not defined.
03A0H	Remote exchange signature does not match.
04A0H	Request data length is invalid.
05A0H	Response data length is invalid.
06A0H	Invalid memory type selector or address range at remote device.
07A0H	Password protection does not permit access at remote device.
08A0H	Attempt to write to a consumed exchange; this is not permitted.
09A0H	Internal resource error at remote device (memory allocation failed, etc.)
0AA0H	Message delivery error; command was not processed.
0BA0H	Software initialization error; command was not processed.
0CA0H	Invalid RDS session was specified.
0DA0H	Data buffer length is invalid.
0EA0H	Invalid response message from remote device.
0FA0H	Address type is not supported at remote device.
10A0H	A memory access error occurred while processing this command.
11A0H	Remote device did not understand the request.
12A0H	Remote device has no variable defined at the specified address.
13A0H	An attempt was made to write a Read-Only variable at remote device.
14A0H	Data length or contents are invalid for transfer according to the data type of that variable at remote device.
15A0H	Response message would exceed max response size (1400 bytes).
50A0H	The remote server detected an unsupported protocol version in the request.
51A0H	The remote server did not recognize the requested command.
52A0H	The remote server detected a configuration time mismatch in the request.
53A0H	The remote server detected that the request was not a valid RDS message. The RDS_Header bit (required by RDS version 2.01 and higher) was not set.
54A0H	Attempt to establish a second session to a remote server. Only one session at a time is permitted between this device and each remote server.

Troubleshooting Common Ethernet Difficulties

Some common Ethernet errors are described below. Ethernet errors are generally indicated in the PLC Fault Table and the Ethernet exception log. As previously explained, PLC Faults generated by the Ethernet interface contain Ethernet exception events within the extra fault data. See the *PACSystems Station Manager Manual*, GFK-2225 for detailed descriptions of Ethernet exception events.

COMMREQ Fault Errors

When the PLC CPU attempts to initiate CommReqs to the Ethernet Interface more rapidly than the Ethernet Interface can accept them, the CommReq delivery will fail. The fault output of the CommReq function block will be set and the CommReq will not be delivered to the Ethernet Interface. In this case, the PLC logic program should attempt to initiate the CommReq on another sweep after a very short delay. This condition may arise when the logic Program attempts to initiate greater than 16 CommReqs in the same logic sweep.

Sustained heavy COMMREQ delivery from the PLC CPU to the Ethernet Interface can use a considerable portion of the Ethernet Interface's processing capability. Under heavy COMMREQ load, the Ethernet Interface may discard some received COMMREQs until it is once again able to process further COMMREQs. In such cases, the Ethernet Interface increments the "CmrqDscd" tally; this tally is available via the TALLY C Station Manager command.

Under sustained extremely heavy COMMREQ load, the Ethernet Interface may not respond to Station Manager commands and possibly some non-Programmer data communications. If this occurs, first switch the PLC CPU to STOP mode, which ceases COMMREQ delivery in order to resume normal Ethernet operation. Then modify the PLC logic application to reduce the COMMREQ traffic to a manageable level.

PLC Timeout Errors

PLC timeout errors may occur when the SRTP traffic to the Ethernet Interface exceeds the PLC's ability to process the requests, or when the PLC is unable to deliver mail to the Ethernet Interface.. PLC Timeout errors will take down an SRTP Server connection; in this case, the remote SRTP client must reestablish a new SRTP connection to the Ethernet Interface.

This error is indicated in the PLC Fault Table as:

"Backplane communication with PLC fault; lost request"
with exception Event = 8, Entry 2 = 8

These errors may also be accompanied by any of the following:

"Backplane communication with PLC fault; lost request"
with exception Event = 8, Entry 2 = 6; location = Ethernet Interface

"LAN system-software fault; resuming"
with exception Event = 8, Entry 2 = 16; location = Ethernet Interface

"Non-critical CPU software event"
status code (bytes 5-8) = 80 3a 00 12; location = CPU module

The PLC Timeout condition occurs when the CPU cannot process requests within a specified timeout period. The remedy is to reduce the rate of requests, or increase the processing capacity in the PLC.

Cause	Corrective Action
Heavy COMMREQ traffic.	Reduce the rate at which the logic application sends COMMREQs to the Ethernet Interface.
Heavy SRTP traffic.	Reduce the size, number, or frequency of SRTP requests at the remote SRTP client.
Long PLC sweep time.	Modify the PLC application to reduce the PLC sweep time.
PLC Communication Window set to LIMITED mode.	Change to RUN-TO-COMPLETION mode.

Note: The Backplane-mounted Ethernet module uses the Backplane Communications Window. The RX7i CPU-mounted Ethernet daughterboard uses the Controller Communications Window.

Application Timeout Errors

Application timeout errors include:

- EGD Command timeout errors (COMMREQ Status 0190H at the client)
- EGD consumed exchange refresh errors (Exchange Status 6 or 7).

Application timeout errors can arise for several reasons, including:

- Incorrect destination device address, or destination device not on the network. The communication service cannot be performed.
  Verify that the destination device address is correct and that the destination device is functioning properly. Ping the destination device to check that it is present on the network.
- The network throughput cannot keep up with the traffic generated by the application. This condition can occur when the intervening network components between the application devices cannot handle the volume of network traffic, causing network packets to be dropped.
  For SRTP, this causes TCP retransmissions; repetitive retransmissions can slow the SRTP responses enough that the client detects an application timeout error.
  For EGD, this causes samples to be dropped. If the consumer misses enough samples, it detects a consumer timeout error; when that exchange subsequently receives samples, the consumer may detect a Data with Refresh error.
  This condition typically arises when intermediate network routers or switches lack the buffering or processing capacity to handle the network load. Reduce the volume of traffic on the network, or identify and upgrade the network component(s) that are unable to handle the traffic volume. Consult you network administrator for assistance.

EGD Configuration Mismatch Errors

When using Ethernet Global Data, the produced exchange (defined at the producer) must agree with the consumed exchange (defined at the consumer). The consumer generates an error when the size of an exchange received from the network differs from the configured size for that consumed exchange.

This error is indicated in the PLC Fault Table as:

"LAN system-software fault; resuming"
with exception Event = 28, Entry 2 = 1d

As this error is generated each time the mismatched exchange is received, the Ethernet exception log can quickly fill up with mismatch error events.

Cause	Corrective Action
Producer and Consumer exchange definitions are of different size.	Review the conflicting exchange definitions at the producer and at the consumer. Change the incorrect exchange definition so that produced and consumed definitions are the same size.

If the consumer wishes to ignore certain portions of a consumed exchange, be sure that the length of the ignored portions is correct. The ignored portion is specified as a byte count.

Station Manager Lockout under Heavy Load

Sustained heavy EGD and/or SRTP Server load can utilize all processing resources within the Ethernet interface, effectively locking out the Station Manager function. The Station Manager appears inoperative under either local or remote operation. The Ethernet interface always gives higher priority to data communication functions than to the Station Manager. When the processing load is reduced, the Station Manager becomes operative once again.

This condition is not reported to the PLC Fault Table or Ethernet exception log.

PING Restrictions

To conserve network data buffer resources, the CPU process only one ICMP control message at a time. An ICMP Echo (ping) request that arrives while the CPU is processing another ICMP control message is discarded. When multiple remote hosts attempt to ping the CPU at the same time, some individual ping requests may be ignored depending upon the timing of the ping requests on the network.

The CPU may initiate ping requests to another host on the network via the "ping" Station Manager command. The ping request sequence is restricted to one remote host at a time.

Discarded ping requests are not reported to the PLC Fault Table or Ethernet exception log.

SRTP Connection Timeout

When the Ethernet Interface is abruptly disconnected from a remote SRTP server (for example, by disconnecting the Ethernet cable), the underlying TCP connection attempts to re-establish communication. The SRTP connection in the Ethernet Interface may remains open for approximately 3 minutes 30 seconds while TCP attempts to reconnect; during this interval, the SRTP connection is unavailable. If all the SRTP connections in the Ethernet Interface are in use or otherwise unavailable, a new SRTP server connection must wait until the TCP reconnect time expires on an existing connection.

The SRTP connection timeout is normal expected behavior, and is consistent with other GE Fanuc PLC products.

Sluggish Programmer Response after Network Disruption

The network programmer attempts to use a special “privileged” SRTP server connection at the Ethernet Interface in order to establish and maintain connection even under heavy load due to EGD and other SRTP connections. The Ethernet Interface supported only one such privileged connection. Once established, no other privileged connections are permitted until the current privileged connection is terminated. This normally occurs when the network programmer disconnects from the target PLC.

As described above under “SRTP Connection Timeout”, when the programmer-PLC network connection is abruptly broken (not the orderly termination performed during disconnection), the SRTP server connection and its underlying TCP connection remain alive until the TCP connection eventually times out (about 3 minutes 30 seconds). If the programmer reconnects during this interval, it actually obtains a new, non-privileged connection. Under heavy load at the Ethernet Interface, the programmer may experience sluggish response over this non-privileged connection. If this occurs, the user can manually disconnect and reconnect the programmer after the previous connection has timed out. Upon reconnection, the programmer should once again obtain the privileged connection.

EGD Command Session Conflicts

EGD Commands support only one pending EGD command from a client device to each server device. Attempts to issue a second EGD command from a client to the same server before completion of the first command will result in an error. Some examples are:

1. The logic application issues a second EGD Command COMMREQ to the same remote server, perhaps from a different location in the logic program.
2. The EGDCMD Station Manager command issues a command to the same remote server device as the logic application.

Appendix A Configuring Advanced User Parameters

Advanced User Parameters (AUPs) are internal operating parameters used by the Ethernet interface. For most applications, the default Advanced User Parameters should not be changed.

If it is necessary to modify any of these parameters, it must be done by creating an AUP file, using any ASCII text editor. This file must contain the names and values of only those parameters that are being changed. This user-generated AUP file is then imported into the programmer and assigned to a particular Ethernet Interface. To modify Advanced User Parameters in more than one Ethernet Interface in the same control system, import an AUP file for each Ethernet Interface. (If the changes are identical, you may use the same AUP file for more than one Ethernet Interface.)

When the entire hardware configuration is stored from the programmer to the CPU, the programmer also stores the parameters from all assigned AUP files. The CPU delivers any assigned AUP file data to its Ethernet Interface along with its configuration. AUP file data is transferred along with the rest of the hardware configuration during both download (programmer-to-CPU) and upload (CPU-to-programmer) operations. AUP file data is also included in the configuration Verify operation between programmer and CPU. Note that there may be a separate AUP file for each Ethernet interface (or some may have them while others do not).

If an Ethernet Interface is not configured by the programmer, its Station Manager can be used to locally modify the Advanced User Parameters for that individual module. (Setting the IP address/subnet mask via BOOTP or the “SetIP Tool” does not qualify as a programmer configuration.)

Caution

The IEEE 802.3 standard strongly discourages the manual configuration of duplex mode for a port (as would be possible using AUP.) Before manually configuring duplex mode for a port using AUP, be sure that you know the characteristics of the link partner and are aware of the consequences of your selection. In the words of the IEEE standard: "Connecting incompatible DTE/MAU combinations such as full duplex mode DTE to a half duplex MAU, or a full-duplex station (DTE or MAU) to a repeater or other half duplex network, can lead to severe network performance degradation, increased collisions, late collisions, CRC errors, and undetected data corruption."

Note: If the speed and duplex mode of a port are forced using Advanced User Parameters, the switch will no longer perform automatic cable detection. This means that if you have the switch port connected to a switch or hub port you must use a crossover cable. If you have the switch port connected to the uplink port on a switch or hub or if you have the switch port connected to another Ethernet device you must use a normal cable.

Format of the Advanced User Parameters File

The AUP file must have this format:

AUP_***r_s***

*where **r** and **s** indicate the Rack and Slot location of the Ethernet Interface*

<parameter name> = <parameter value>
<parameter name> = <parameter value>
<parameter name> = <parameter value>

The AUP file has the following requirements:

- The first line of the file must consist only of the text: AUP_***r_s***
  where ***r*** and ***s*** usually indicate the Rack and Slot location of the Ethernet Interface.

  (For example, an Ethernet Module is rack 0, slot 11 would be indicated as AUP_0_11. The CPU-embedded Ethernet Interface always uses Rack 0, Slot 1.)
  This was intended as a convenient way to differentiate AUP files for different modules. Any rack and slot number will do, so that the same AUP file could be imported for use by multiple Ethernet interfaces if desired.
- All parameter names are lowercase. The equal sign (=) is required between the parameter name and parameter value.
- Spaces are allowed, but not required, between the parameter name and the equal symbol (=) and between the equal symbol and the parameter value.
- Character string values are case-sensitive; as with Station Manager commands, uppercase parameter values must be enclosed within a pair of double quotes.
- Numeric parameters are entered in decimal or hexadecimal format; hexadecimal values must be terminated with an 'h' or 'H' character.
- IP addressing parameters must be entered in standard dotted decimal format.
- Comments in the file must start with a semicolon character. All characters in the same line following a semicolon are ignored.
- Blank lines are ignored.

Example:

The following example sets the station manager password to “system” and the IP time-to-live for point-to-point Ethernet Global Data exchanges to 4.

```
AUP_0_1
stpasswd  =  “system”     ;        set the password to “system”
gucast_ttl=4              ;        set the EGD unicast IP TTL to 4
```

Advanced User Parameter Definitions

The following Advanced User Parameters can be configured for the Ethernet interface.

System Memory Parameters (task b)		***Default***	***Range***
staudp	Remote command UDP port	18245 (4745H)	0 – 65535 (ffffH)
stpasswd	Station Manager password (only visible from MODIFY prompt)	"system"	0-10 characters, case sensitive, no spaces
Backplane Driver Parameters (task c)			
crsp_tout	CPU response timeout. Amount of time to wait for the CPU to respond to a request sent through the PLC Driver.	60 seconds	10 – 3600 (E10H)
RDS Parameters (task d)		None	None
ARP Parameters (task f)		***Default***	***Range***
fflush	Interval in seconds at which to flush the ARP cache	600 (0258H)	0 – 604800 (93A80H)
Ethernet Global Data Parameters (task g)			
gctl_port	UDP port for EGD control messages	7937 (1f01H)	0 – 65535 (ffffH)
gdata_port	UDP port for point-to-point (unicast) EGD messages	18246 (4746H)	0 – 65535 (ffffH)
gbcast_ttl	IP time-to-live for global broadcast messages (hop count)	1 (1H)	0 – 255 (00ffH)
gucast_ttl	IP time-to-live for point-to-point (unicast) messages (hop count)	16 (10H)	0 – 255 (00ffH)
gp_phase	Startup delay time in ms for successive produced exchanges	0 (0H)	0 – 65535 (ffffH)
gcmd_pri	EGD command processing priority. 0 = EGD commands have lower priority than data production. 1 = EGD commands and data production have equal priority. 2 = EGD commands have higher priority.	0 (0H)	0, 1, 2
EGD provides a UDP port parameter and host group IP address parameter for each of 32 possible host groups (0-31). The parameter formats for each host group are shown below. XX specifies host group 0-31.			
gXX_udp	UDP port for host group XX	18246 (4746H)	0 – 65535 (ffffH)
gXX_addr	IP time-to-live for host group XX (must be Class D address)	224.0.7.XX	224.0.0.2 – 239.255.255.255
gXX_ttl	IP time-to-live for host group (multicast) messages (hop count)	1 (1H)	0 – 255 (00ffH)
IP Parameters (task i)		***Default***	***Range***
ittl	IP header default time–to–live (hop count)	64 (0040H)	0 – 255 (00ffH)
ifrag_tmr	IP fragment timeout interval in seconds	3 (0003H)	0 – 65535 (ffffH)
ICMP/IGMP Parameters (task j)		None	None

Network Interface Parameters (task l)		***Default***	***Range***
lduplex0	Ethernet duplex for Controller (1 = half, 2= full)	2	0,1,2
lduplex1a	Ethernet duplex for Port 1A (0=auto-detect, 1=half, 2=full)	0	0,1,2
lduplex1b	Ethernet duplex for Port 1B (0=auto-detect, 1=half, 2=full)	0	0,1,2
lspeed0	Ethernet speed for Controller (1=10Mbit, 2=100Mbit)	2	0,1,2
lspeed1a	Ethernet speed for Port 1A (0=auto-detect, 1=10Mbit, 2=100Mbit)	0	0,1,2
lspeed1b	Ethernet speed for Port 1B (0=auto-detect, 1=10Mbit, 2=100Mbit)	0	0,1,2
UDP Parameters (task u)		None	None
SRTP Parameters (task v)		None	None
TCP Parameters (task w)		***Default***	***Range***
wnodelay	TCP nodelay option (0= inactive; 1 = active)	0 (000H)	0, 1
wkal_idle	TCP keepalive timer value (in seconds)	240 seconds (= 4.0 min)	0 – 65535 (ffffH)
wkal_cnt	TCP keepalive probe count	2	0 – 65535 (ffffH)
wkal_intvl	TCP keepalive probe interval (in seconds)	60 seconds	0 – 65535 (ffffH)
wsnd_buf	TCP send buffer size (in bytes)	65535 (ffffH)	0 – 32767 (7fffH)
wrcv_buf	TCP receive buffer size (in bytes)	4096 (1000H)	0 – 32767 (7fffH)
FTP Parameters (task t)		***Default***	***Range***
tpassword	Password for login for FTP access.	“system”	0 to 16 characters
Ethernet Redundancy Parameters (task q)		***Default***	***Range***
rdipckival	Interval between additional checks for Redundant IP in use (in milliseconds)	100 (0064H)	1 – 1000ms
rdiparpivl	Interval between gratuitous ARP requests sent by the backup unit on behalf of the new active unit (in milliseconds).	100 (0064H)	1 – 1000ms
rdipnumarp	Number of gratituitous ARP requests to send out during Redundant IP activation process.	1 (0001H)	1 - 25
rdiparplog	Number of gratituitous ARP requests to send by backup unit before a “Redundant IP not available” exception is logged. (The backup unit will continue to send ARP requests as long as it receives network packets addressed to the Redundant IP Address.)	5 (0005H)	1 – 25

A

Advanced User Parameters, A-1
Application Timeout, 8-24
AUP file, A-1

B

BOOTP, 3-5, 3-8
Broadcasting Ethernet Global Data, 4-7

C

Cable
  Ethernet, 1-5
COMMREQ, 8-12
COMMREQ Fault Errors, 8-23
COMMREQ Format for Programming EGD Commands, 5-2
COMMREQ Status, 8-13
Configuration Data, 3-2
Configuration Mismatch, 8-25
Configuring Ethernet Global Data, 3-12
Configuring the Ethernet Interface, 3-7
Consumed Data Exchange Definition, 3-15
Consumer, 4-2

D

Documentation, 1-1
Downloading PLC Web Pages, 7-11

E

EGD Command Session Conflicts, 8-26
Embedded switch, 2-8
EOK LED, 2-4
Ethernet Global Data, 4-2
  Configuring, 3-12
  Consumed Data Exchange Definition, 3-15
  Consumer, 4-2
  Effect of PLC modes and actions on, 4-14
  Exchange, 4-3
  Exchange Status Word, 4-15
  Operation, 4-8
  Produced Data Exchange Definition, 3-13
  Producer, 4-2
  Selective Consumption, 3-17
  Variables, 4-3
Ethernet Port Connectors, 2-8
Ethernet Restart Pushbutton, 2-2
Exchange Status Word
  Ethernet Global Data, 4-15

F

Fault table, 8-7

G

Gateways, 6-4

H

Hardware failure, 8-5
Hot Insertion and Removal, 2-7
Hub/Switch/Repeater, 2-11

I

I/O Fault Table, 7-10
IC200CBL001, 2-12
Installation, 2-5
IP address
  Configuration, 3-8
  Isolated network, 3-9
IP Address Assignment, 3-3
IP Addressing, 6-2

L

LED Blink Codes, 8-6
LEDs, 2-3, 2-13, 8-4
Loopback IP Addresses, 6-3

M

Masked Write to EGD Exchange, 5-16
Multicast IP Addresses, 6-3
Multicasting Ethernet Global Data, 4-6

N

Name Server IP address, 3-8, 3-9
Network time sync, 3-9

O

Operating States, 8-4
Operational state, 8-5
Overtemperature, 8-11

P

PING Restrictions, 8-25
Pinging the TCP/IP Interfaces on the Network, 2-14
PLC Fault Table, 7-7, 8-7

PLC Timeout Errors, 8-23
Port LEDs, 2-4
Port Pinouts, 2-10
Port Settings, 2-12
Power-up states, 8-4
Produced Data Exchange Definition, 3-13
Producer, 4-2
Producer Period, 4-9
Programmer Response, 8-26

R

Read EGD Exchange command, 5-10
Read PLC Memory command, 5-4
Redundancy, 4-5, 5-1, 7-2, 8-11
Redundant IP, 3-10
Redundant IP address, 8-11
Reference Table Data, 7-5

S

Scan Set, 3-10
Serial port configuration
  Data rate, 3-11
  Flow control, 3-11
  Parity, 3-11
Simple isolated network configuration, 3-9
SNTP Operation, 4-12
SNTP Timing Signals, 4-13
Software Loader, 8-5
SRTP Connection Timeout, 8-26
STAT LED, 2-4
Station Manager, 8-3
Station Manager, 1-5
Station Manager (RS-232) Port Pinout, 2-12
Station Manager Lockout under Heavy Load, 8-25
Station Manager Port, 2-12
Status address location, 3-9
Status Bits, 8-10
Subnets, 6-5

T

Telnet, 3-6
Timeout Period, 4-9
Timestamping of Ethernet Global Data, 4-11
Troubleshooting, 8-3

W

Waiting for configuration from PLC, 8-5
Waiting for IP address, 8-5
WEB Server Operation, 7-2
Write EGD Exchange command, 5-13
Write PLC Memory command, 5-7